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John A. Hill

THE engineering profession, no less than the publishing world, suffered a severe loss in the death early this week of John A. Hill. Long known to the mechanical world through his ownership of the *American Machinist, Power,* and the *Engineering and Mining Journal,* he came to the attention of civil engineers and contractors through his purchase nearly four years ago of *Engineering News.* In the new field, as in the old, he won hosts of admirers for his steadfast upholding of the highest standards of technical journalism. No attack by advertisers on editorial policy could weaken his determination to place the interests of the reader first, and while those who could not break down this policy demurred at first, they admired the principle of the man and came to learn that only through the policies he adhered to could mediums be built up that could be of real service to reader and advertiser. With such standards his journals could not but have a great influence upon their respective fields. No one can measure what they have done for the advancement of engineering, for no human agency can follow ideas from their seed, an article or an editorial, to mature growth in an engineering structure or an industrial organization. That the influence was a very strong one, however, no one can doubt, for otherwise the large circulations his publications enjoyed could not have been maintained. Personally, he was the type of man it is a pleasure and an inspiration to watch. One had instinctively to give him the credit that the strong man—the strong man mentally and physically—exacts. He was a fighter—a dominant personality—but one that sought not the embittered conflict. He was a man who made his decisions without wavering, and yet his forcefulness and dominant personality were happily tempered with kindness, and mellowed by the long and hard experiences of his rise from a mechanic to the presidency of one of the greatest of technical publishing organizations. He will be missed, sorely missed, by those who have observed carefully the development of technical journalism and particularly by those who have aided in that development.

Economists as Regulators

COMMENTING on the Newlands resolution for a joint congressional commission to investigate railroad regulation, *The Nation's Business,* published by the Chamber of Commerce of the United States of America, concludes as follows: "It will occur to most of us that there might well be several business men on such a commission; also that there is some good sound sense in the suggestion of the *Saturday Evening Post* that Congress could save much time and money by asking the assistance of the economic departments of some of our great universities." The Engineering Record regrets that the last part of this sentence, coming from the Chamber of Commerce, is so sweeping. Seemingly that body has not had enough experience with economists to realize that they need to be selected with care. The Engineering Record has full confidence in the wisdom of some of the economists, but warns against others who have had no contact with the actual raising, handling and spending of large sums of money, and who try to apply laboratory theories to great living industries. *The Nation's Business* ought to have pointed out the difference in the two types of economists.

The Alvord Honor Award

IT was a fine thing for the engineering profession and for those who have unbounded faith in the humanitarianism of engineers to witness the enthusiasm with which the $1,000 gift of John W. Alvord to the Western Society of Engineers for a fund for inconspicuous public service was received at the recent annual dinner. The medal can be made a splendid tribute to engineering service now little known if a great society can endow it with the proper honorary spirit. It is true that great benefits often accrue to the public at large through valuable improvements in the arts which are given without personal reward or gain. It is the duty of engineering societies to point out to their members and to the public such instances of engineering and administrative skill as seem to have unusual merit, in order that honor may be properly accorded where it is due. Recognition of the engineer's services to the public by his peers should be of the highest honor and value to him. The public will be served the better and engineers will feel a keener incentive to put forth a greater creative effort because of the Alvord honor award.

Engineers for Commissionerships

TO those engineers who have advocated that technically trained men should be represented in the membership of public service commissions there is much encouragement in the Engineering Record's interview, in the news section, with Oscar S. Straus, the new head of the Public Service Commission controlling New York's subways. To Commissioner Straus an engineer means more than a subordinate who can run a transit. He realizes that the profession numbers among its members broad-gage men of administrative capacity who are eminently qualified to perform the duties of a commissioner, and when such men can be found he is heartily in favor of their appointment. In the case of the New York Commission, to which Henry W. Hodge, an engineer, was recently appointed, fully half of the problems are construction problems, and if a man combine technical knowledge with the necessary executive qualifications, his services as a commissioner should be doubly valuable. In the average lay mind this conception of the engineer-commissioner is still somewhat hazy, and Commissioner Straus's views will be decidedly helpful in molding popular opinion into a proper form. Mere engineering experience, however, is no index of a man's fitness for a commissionership, even on a board controlling engineering work. Personality, business sense, broad vision, and a judicial temperament are all essential. If to these attributes engineering knowledge and experience are added an ideal combination is formed. State executives with appointive power will do well to weigh carefully Commissioner Straus' words when there are vacancies to fil on regulating boards.

A Coming International Obligation

LAST week the *New York Times* printed an interview between James O'Donnell Bennett and the Rector of the University of Leipsig, in which the latter argued that science and the universities should be the first, after peace is declared, to bind together again the peoples of the countries now at war. It should be their work, as the Rector expressed it, to "bring anew to their (the warring nations') consciousness the fact that in this world of self-interest and of strife there is also a bright world of spirit and of thought which counts no cannon in its equipment and demands no bleeding victims as the price of victory." Should not engineers, also, take to heart the Rector's words? With an eye single to the advancement of the interest of the human race are they not well fitted to brush aside the bitterness of discord and to bring together the peoples now at each other's throats? But further than that, should not the engineering profession in America prepare itself to take the initiative, after the war is over, in bringing about again close relations among the engineers of the European nations? International engineering congress after congress has been postponed—the International Road Congress, the International Congress on Testing Materials, the International Navigation Congress. What nation will be better fitted to bring together those that are now enemies than the United States? It would be a fitting and worthy thing for the engineering profession in this country to take the initiative, after the war, to re-establish these international congresses, and here, in the land of a neutral, to have the first meeting of each of these international bodies after the cannon's roar has subsided. It is a duty which the engineering profession and the engineering societies of this country should prepare for. They can render an inestimable service by re-establishing the international organizations. Not only the profession, but humanity at large, will be the gainer through the more rapid healing of the wounds of conflict thereby brought about.

An Extraordinary Contract

EFFICIENCY methods in handling construction are being more and more recognized as the contractor's biggest asset in securing work and in making money. An astonishing example of what planning and management can do is brought out in the description, on page 152, of the new methods and plant by which the Holbrook, Cabot & Rollins Corporation will be able to finish in twenty months a section of subway work for which forty months would ordinarily be required. Only two larger single sections of subway work, not counting river crossings, have been contracted for in New York City. Both were under little-traveled streets, four years was allowed for completing each and the average monthly value of work done on both was $82,000. For the completion of the other sections of the new Broadway subway, of which the one under discussion is the last let and the connecting link, an average time of 35.4 months was allowed, and the average monthly value of work required on them is only $56,000. The magnitude of the task confronting the contractors for the last link is, therefore, strikingly shown by the fact that they must spend an average of $187,000 a month to complete this section in the twenty months allowed. It includes thirteen of the most densely-traveled city blocks in the world, requires the construction of a crossing under the existing subway without interrupting four-track traffic, and is served only through narrow and congested cross-streets in which all material must be handled. At first sight the contract seems impossible. Nevertheless, by the application of efficient construction methods, made to order out of whole cloth where no precedents existed, it is being done. Needless to say, George Hallett Clark and his Broadway subway section are being watched with the keenest interest by everyone connected with this class of work.

A Model Construction Camp

IN this year of high cost of material labor will be none the less hard to obtain, and the contractor who must provision and house his force would do well to reduce to a minimum by all legitimate means the "going" gang so that the "working" and "coming" gang may be as large as possible. Good food, comfortable bunk houses and a well-ordered camp will help in keeping men on the job.

The builders of the hydroelectric plant on the Chippewa River at Wissota, Wis., realizing the necessity of caring well for its 1000 employees for the fourteen-month construction period in the wilderness have built a model camp and included a store, a moving picture theater, an electric light plant, waterworks, a sewer system, a laundry, a bath house and a hospital. Each bed is of the double-deck type and has a real mattress of good quality. The regulations require the bed linen to be changed once a week, and whenever there is a new occupant. No liquors are sold. Every man must bathe at least once each week and must send his washable clothing to the laundry each week. The minimum quality of the food supplied and its variety are all matters of exact contract and specification. No metal plates are permitted. The china is not Haviland or Limoges, but it is of good, honest American make.

Food specifications are of interest when, as the bulletin issued by the owners, the American Public Utilities Company, states, one has only to scratch an old woodsman to hear more interesting than appetizing stories of the "salt horse" diet of the olden days. No forequarters of beef are to be purchased and no shoulder beefsteak is to be served. Bread must be supplied fresh every day and none over thirty-six hours old is to be used. Kitchen refuse must be destroyed each day and all the quarters must be free from flies. Even details as to menus are specified and their rehearsal will make many a white-collar man restless. For instance, for breakfast the men must be supplied, in such quantity as each chooses to use, rolled oats, beefsteak, pork chops or bacon, boiled or fried potatoes, bread and real butter, doughnuts or cookies and tea or coffee. As to the cost of all this high living, board and lodging costs $5 per week and single meals 25 cents.

Contractors nearer civilization who have already begun to find difficulty in keeping their ranks filled with efficient men, will probably find before the coming season is over that similar "creature comfort" inducements will pay. Can the plan be carried out so successfully on more temporary work and within the confines of a city?

What Should Be the Education of the Engineer?

A MOST interesting subject for study and discussion was opened up at the annual meeting of the American Society of Civil Engineers last week by Prof. C. R. Mann, who is making the investigation for the Carnegie Foundation into engineering education. As shown in the report of the meeting in the Engineering Record, Jan. 22, pages 125 and 126, replies from 1500 practising engineers indicate that general qualifications, such as character, judgment, and executive ability, are rated as worth 87 per cent in the success of an engineer, while only the remaining 13 per cent is given as the weight of technical knowledge and practical engineering experience.

That the result of Professor Mann's canvass agreed with the views of the members of the society present was clearly evident by the applause which greeted his statement of the result. If the engineers who have reported their views have put the matter correctly it is apparent that we must write a new definition of what makes an engineer, and, after having written that new definition, must inquire into the type of instruction needed to produce the desired product. At the present time the conscious effort of the schools is being given almost entirely to the importing of that part of an engineer's equipment which is rated at only 13 per cent. Undoubtedly the colleges do something toward giving him the qualities which weigh 87 per cent, but they are by-products, not consciously sought for save as the individual instructor here and there may fashion his work.

A mere statement of the case is sufficient to open up vistas of what may happen in our engineering colleges when the full import of Professor Mann's findings are realized. There must come a recasting of courses and methods which will be most revolutionary. And between that revolution and a continuance of present methods lies only a more positive determination of the correctness of the views that Professor Mann has collected.

As to the correctness of his analysis this journal has no doubt. In fact, the views expressed in recent years by practising engineers have all tended to prepare one for these findings, radical as they are. Individual addresses have been made, too, which have clearly foreshadowed some such results. Professor Swain's address before the meeting of the American Institute of Electrical Engineers somewhat over a year ago is one of those addresses. The profession generally, however, and the engineering colleges will need to ponder the results quite carefully before they are willing to undertake the needed revision. That must come by a process of education, and through discussion in the technical press and the engineering societies.

Professor Mann was most conservative in his presentation of the matter. He might well have dogmatized, with the reviews of 1500 engineers in hand. Instead, he stated the problem as not yet solved, and appealed to the members not only of the American Society of Civil Engineers, but to all practising engineers to assist him in gathering fuller data, so that what results are given out as final may be correct beyond any chance for reasonable doubt.

The Engineering Record cannot urge too strongly upon the members of the profession throughout the United States the need for serious consideration of Professor Mann's work. It urges, too, that when he calls for further action, whether by the expression of individual views in answer to circulars and letters or by meetings of technical bodies across the country, the response will be most hearty. The work he is doing is of fundamental importance to the future of engineering in this country. He deserves hearty co-operation of everyone worthy to bear the name of engineer.

Committee Work Essential for National Engineering Society

IN opposing a motion at last week's meeting of the American Society of Civil Engineers to increase the membership of a committee several speakers pointed out that the expense of committee work is becoming very heavy, and as one of them put it "is in danger of running away with the society." None of the speakers was opposed to committee work, but merely pointed out a fact that a considerable sum, over $10,000, is now devoted to the expenses of committees.

One is likely to demur at once from characterizing committee work as running away with the society when an expenditure of only $10,000 is made for the work. A study of the disbursements, shown in the secretary's report to the Board of Direction, would lead one to question at least whether it would not be best to curtail expenses in other directions and expand the committee work. This journal certainly feels emphatically that the committee work of the society needs to be broadened.

In professing its faith in committee work the Engineering Record does not necessarily indorse the appointment of some of the present and recent standing committees. In its judgment there are far more important matters neglected than are now covered by existing committees. While there will be disagreements, of course, there seems to be far greater need for committees to draw up specifications for paving work than for committees to investigate a national water law or the bearing power of soil. Without a doubt other important phases of engineering need to be covered by committee assignment, but some attention to the present situation in the making of specifications covering paving work will indicate that the society needs to expand its committee activities rather than to curtail them.

The society now most prominent in drawing up paving specifications is the American Society of Municipal Improvements. Its procedure is nothing short of a disgrace to the engineering profession. The method of handling committee work is exceedingly lax, and provision is not made for that long and careful consideration which should be demanded before any specification is labeled as a standard by a national body. Anyone knowing the procedure in the American Society of Municipal Improvements will take the specifications at their real value, but there are engineers throughout the country, not familiar with the procedure, who give them a standing not warranted by the method pursued.

If the American Society of Civil Engineers were writing paving specifications, it is safe to assume that the American Society of Municipal Improvements would give way to the more important body and confine its activities to an interchange of views among engineers engaged in municipal work. But until the larger organization does take its responsibility, one must look for a continuation of work by the municipal body.

While there may be other directions in which committee work is needed, the Engineering Record submits that in paving matters there is not only an immediate opportunity, but an immediate demand, for the attention of the American Society of Civil Engineers. This journal feels that the membership of the society at large will heartily favor expansion rather than contraction of committee work.

Course in Aeronautical Engineering

UNTIL recently progress in the development of flying machines and dirigibles has been based largely upon rule-of-thumb methods, costly in life and money, and showing, in many cases, little engineering appreciation of the complex problems involved. It is not surprising that an art so new as aviation should have depended so much upon empirical methods, but even before the outbreak of the European war, in which the service of the aeroplane has been literally invaluable for scout duty, steps had been taken, both in this country and abroad, to establish aeronautics upon an engineering basis. Pioneer work of great value has been accomplished by the National Physical Laboratory in England during the last few years under the general direction of Dr. R. T. Glazebrook; research has been vigorously prosecuted at the laboratory of the University of Gottingen, in Germany; and the industrial testing of air-craft, corresponding to the work of the ship model tank in naval architecture, attained an advanced status at the Eiffel and St. Cyr laboratories in France prior to the opening of hostilities.

In the United States the Massachusetts Institute of Technology opened in 1914 the first course in aeronautical engineering to be offered on this side of the ocean, and as the second year of the Institute's work in this specialized realm began last fall, attention may properly be called to the purposes and methods of those responsible for this important branch of educational and research activity. Without depreciating the contributions of American scientists and aeroplane builders to the art of aviation, President Maclaurin emphasized some time ago the need of freeing air-craft from its more serious dangers, establishes aeroplane and dirigible design upon a scientific basis and, preparing to supply specially trained engineers to meet future demands for economical and safer construction in both military and civil flying equipment. Based on the broad relationships of the naval architect, the mechanical engineer, the physicist and the meteorologist, the course was planned for a very limited number of graduate students qualified by the Institute's bachelor degree in mechanical or electrical engineering or naval architecture or by graduation from other institutions affording adequate preparation.

The course is laid out to furnish training in the design and construction of air-craft of all kinds and is attached to the department of naval architecture, being in immediate charge of Jerome C. Hunsaker, assistant naval constructor, U. S. N., who is detailed for this duty by the Secretary of the Navy. No attempt is made to give instruction to pilots in the operation and control of such craft, but the endeavor is to train men who are already engineers to undertake the experimental development of air-craft, their manufacture and maintenance. Previous preparation in physics, advanced mathematics, the strength of materials and machine design is, therefore, absolutely necessary, and the year required as a minimum for the attainment of the master's degree is crowded with theoretical and experimental studies.

The Institute is fortunate in possessing an aerodynamic laboratory equipped along the lines of the celebrated English plant mentioned above, with a wind tunnel in which an air velocity of about 40 miles per hour can be maintained for the testing forces and couples produced on model air-craft and parts, offering extended facilities for industrial testing and scientific research leading toward the production of specified results at reduced cost, verification of laws and formulas, the determination of new constants, checking of details in design, study of lift, impact, stability and many other elements of the problem of air transportation. The curriculum includes extended studies of fluid dynamics and of the dynamics of rigid bodies, wireless telegraphy, meteorology, explosion motors, and air-craft design in extended ramifications, leading to a thesis embodying the results of an original research in aeronautics.

It is to be hoped that this work will be a potent factor in the progress of aeronautical engineering in America, and that greater encouragement to scientific research will result from such a recognition of the importance of adequate training in this complex technical specialty. Italy and Russia long since established either governmental or university laboratories for aeronautical investigation, and the United States has lagged too far behind European nations in making use of the fruits of its own pioneer development. The results of a number of investigations conducted at the Massachusetts Institute of Technology are now in the hands of the Smithsonian Institution for subsequent publication, and the possibilities of co-operation seem attractive. There is little question that the interest of the public in military preparedness will embrace aviation, and if anything like adequate appreciation of the value and importance of technical investigation and education along this line is secured, an impetus to the further development of the art will be given which will be worth its cost many times over.

Belt Conveyors a Success in Pneumatic Tunnel Construction at Boston

System Allows Muck to Be Handled Through All Other Work to Cars in Completed Tunnel—Full Crew Kept Busy at Each Operation at All Times

ALL THE WORK of mucking, lining with wood blocks, concreting the invert, waterproofing, concreting the main tunnel section and grouting is being carried on simultaneously and without interference in driving the twin Dorchester tunnels under Fort Point Channel in Boston. In sharp contrast to the well-known methods by which large pneumatic tunnels have heretofore been constructed, all the independent operations that go to make the finished tunnel are being carried on simultaneously without interference in one short stretch of heading just behind the shield. Concrete is supplied and muck is taken away with a novel layout, so successful in its working that monthly progress so far has easily averaged from 320 to 370 ft. in each heading. On many days more than 14 ft. has been driven, lined, waterproofed and concreted in each heading.

BELT CONVEYORS BIG FACTOR

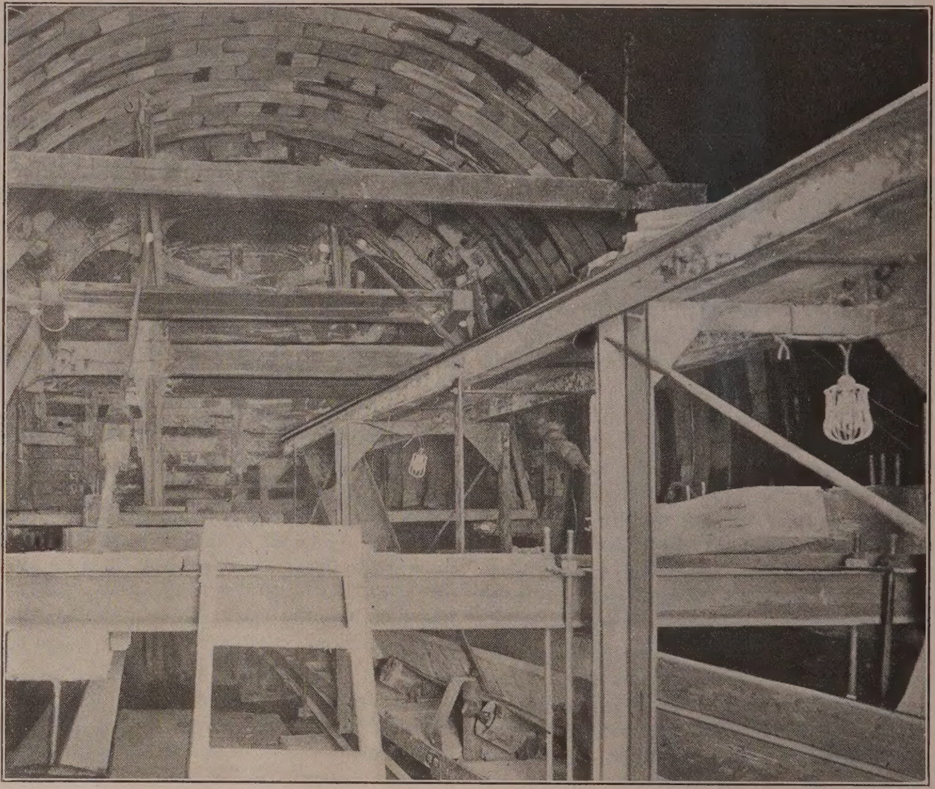
The first factor in the layout which is making this progress possible is a belt conveyor in each heading. These conveyors carry muck back from the shields through all the other work, and occupy only a small space in the center of the tunnel. The muck cars are handled on a track at the side of the conveyor, and are loaded by it behind the end of all the finished concrete work except the concrete arch, which is turned in the rear of the conveyor. Outside of these tracks is a rail on either side, on which run the concreting platform and the form carriage. These rails are laid on the finished invert and one concreting carriage is always kept just ahead of the last side-wall arch form and the other just behind the belt conveyor.

Between the two concrete platforms is another platform, hung from eye-bolts in the wood-block lining of the roof, from which the waterproofing is done. The invert is waterproofed under the rear shield platform, from which the wood-block lining is handled. This last platform, at a level with the top of the belt conveyor, is attached to and bracketed out behind the shield, and supports the belt conveyor over the gap from the shield to a point from 20 to 30 ft. behind the shield where the invert is in place. The shield, lining platform and conveyor all travel forward together. The conveyor rides one of the two material tracks in the tunnel. The conveyor is so long that a few hours' or even a day's delay in driving would not hold up the other work.

UNDERGROUND RAILROADING

To take into each heading 70 cu. yd. of concrete, from 7000 to 8500 ft. b.m. of wood-block lining, waterproofing materials and cement for grouting, and to take out 190 to 230 cu. yd. of muck in 24 hr. would seem to be a task to tax the carrying capacity of even a double-track line. As a matter of fact, however, a large part of the time only one track is in service, and the limiting factor in the whole progress of the tubes is the amount of muck that can be excavated and shoveled upon the conveyor by as large a crew as can find room to work in the shield.

When the invert is being concreted each train is made up with a platform car of lining blocks in front, two 1-yd. concrete cars next, then four muck cars and last the storage-battery electric locomotive. A complete train can be handled through the long material lock at the shaft end of each tunnel. At the heading, the platform car is dropped down to the shield, the concrete cars stop at the concrete platform and the four 2-yd. muck cars are cut off and handled by the locomotive at the discharge chute of the conveyor. While the cars are there the crew at the face shovels as hard as possible to keep the conveyor full. By the time the concrete cars have been dumped, the 8 cu. yd. of muck is loaded, and the train is coupled up and taken back to the shaft.



PLATFORM AND CONVEYOR HUNG FROM SHIELD OVER GAP AHEAD OF FINISHED INVERT

As yet the haul in the west heading is so short that no empties have to be left at the conveyor. Empties are left at the conveyor in the advance tunnel, which is now 1400 ft. long. During the short time the belt is stopped the mucking gang has plenty to do to pick down enough of the stiff clay face to make the next load. Where sand pockets have been met, boulders have been encountered, and the work of shooting these up has consumed as much time as the pick work in clay.

OPERATION OF SHIELDS

The shields used are shoved by hydraulic jacks, and were described in the Engineering Record of Aug. 21, 1915, page 218. They have two sliding tables, which have been used very successfully to help hold the face when sand pockets were encountered. In stiff clay, after the face below each table and the top of the shield has been picked out, the stiff shelf of material in line with each table is cut down by shoving forward the tables.

The men working in the bottom of the shield shovel directly upon the belt. A short hopper leads to the belt from the lower platform, and a chute leads from the upper platform. At the discharge end of the belt a perforated water pipe supplies a steady trickle which prevents the clay from sticking in the discharge chute. Two men with hoes rake the clay down into the cars or hold it back while the cars are shifted.

CONCRETING HANDLED FROM PLATFORMS

The inside invert form, being simple, is made of wood, and about two sections are carried in each heading. The forward concreting platforms carry a spout on each side and each has an elevator which, when down, fits into the material track. Each elevator is run by a two-drum hoisting engine, using air which is mounted on top of each platform at its rear. The side-dump concrete cars are hoisted and dumped one at a time, and the concrete is shoveled into the chutes for the invert and lower side walls, and directly into the forms for the rest of the section.

The Blaw forms being used for the side wall and arch section have ribs which make them self-supporting when the carriage used to telescope and move the sections is withdrawn. They are made with removable plates. Eight 15-ft. sections are used in each heading. The carriage on which they are collapsed and rolled forward leaves the lower part of the tunnel entirely clear for the material cars. The form installation was described in the Engineering Record of April 17, 1915, page 510.

MIXING PLANT UNDERGROUND

The concrete mixer is located in the main shaft on West First Street, and is fed entirely by gravity from bins under the street, the bins being loaded by bottom-dump wagons. Cement in bags is dropped to the charging platform down a spiral steel chute with a dished wood chute at the bottom. The pitch of the spiral and the vertical curve of the wood chute check the speed of the bags and prevent their sliding fast enough to tear the sacks. The 1-yd. mixer dumps directly into the concrete cars for either heading.

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BOTH DERRICK AND ELEVATORS EMPLOYED IN SHAFT WHICH SERVES ENTIRE TUNNEL

TUNNEL CARS DO NOT LEAVE SHAFT

As the muck cars come out of the tunnel, they are hoisted one at a time on one of the two elevators, run out on a short track and dumped into dirt hoppers large enough to hold about twelve car loads. From here the dirt runs into 4-yd. side-dump cars on tracks below the bins. These cars are hauled on a short elevated railroad to the dock on Fort Point Channel by narrow-gage dinkies, three of which are in use. At the dock the cars are dumped into scows, in which the muck is taken down the harbor for final disposal. Each of the three bottom-dump scows used will easily hold the dirt from a day's run in both headings.

Wood blocks, tools and supplies are not handled on the elevators, but are lowered down an open well in the shaft by a steel stiffleg derrick which was used in sinking the shaft.

Concrete materials are delivered to the job by trucks. The wood lining blocks are delivered, already milled, by lighter, stored at the waterfront and loaded in sixteen-block bundles by a derrick upon platform cars on the disposal trestle. A coal yard runs from the lower end of the dock to Dorchester Avenue, cutting this space off from the rest of the job. In the space between this yard and First Street is the material yard. A locomotive crane running on a track parallel to the trestle handles all cars, buckets and heavy loads.

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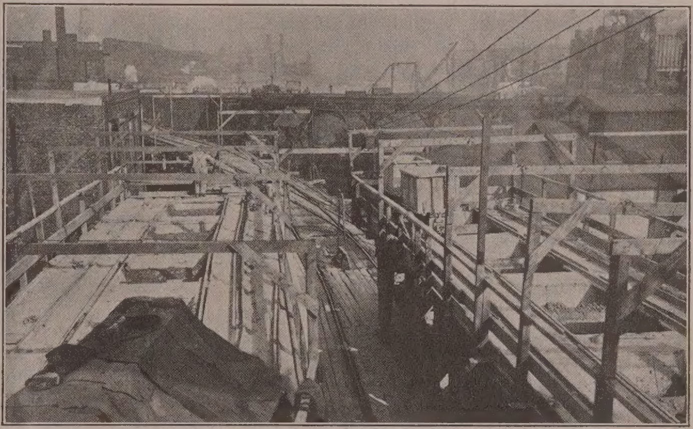
TUNNEL CARS DUMP IN THESE HOPPERS FROM WHICH OTHER CARS TAKE MUCK TO DOCK



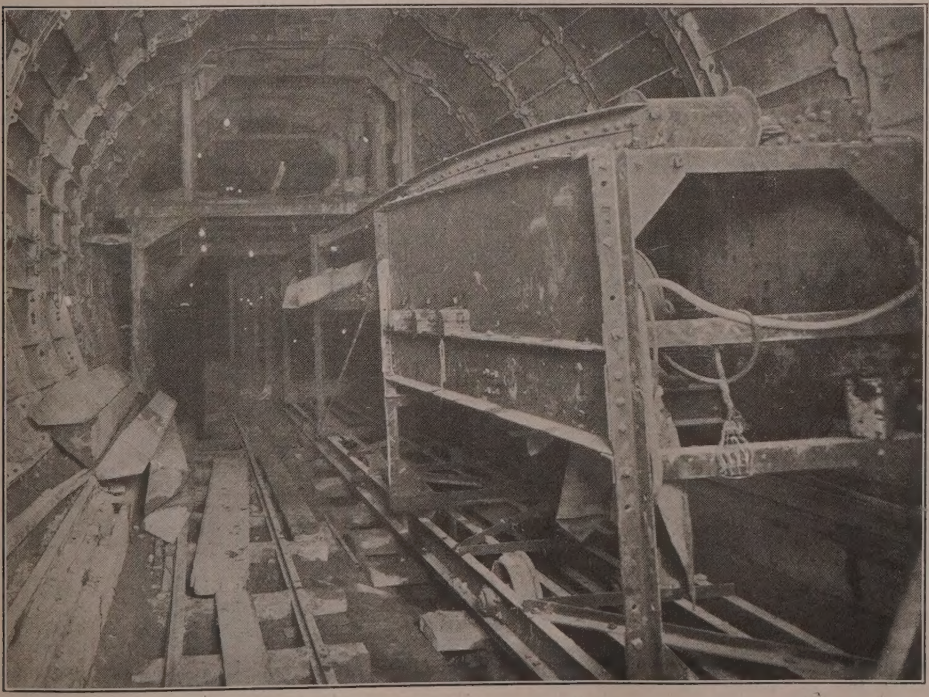
STATIONARY PLANT

On the opposite side of this track from the trestle are located the doctor's office, where a nurse is always in attendance, a two-story dry house with shower baths and lockers for 400 men, a carpenter shop, a machine shop and the compressor plant. The latter is operated by steam, and contains three Sullivan machines of about 2200 ft. capacity each, two small high-pressure air machines for grouting, etc., four high-pressure hydraulic pumps for the shield jacks and two generator outfits for lighting. The stiff clay through which the shields are being driven holds air well, and this air plant has operated much below capacity since the start.

In addition to the plant already mentioned below ground, an extra hoisting engine has been used at the shaft end of each tube to handle cars until the hauls became long enough to make electric locomotives preferable.

This section of the Dorchester tunnel work will be completed entirely from the First Street shaft, as facilities for disposal were poor at the Summer Street end of the section. A maximum haul of nearly 3000 ft. will result, which, however, is not expected to slow up the work.

The tunnel is being driven by Patrick McGovern & Company for the Boston Transit Commission, of which Prof. George F. Swain is chairman and Edmund S. Davis chief engineer. G. D. Emerson, assistant engineer, is in direct charge of this and the adjoining sections for the commission. Patrick McGovern and A. A. Cohill, his chief engineer, worked out the construction details and are taking personal charge of the work. Charles R. Gow is consulting engineer for the contractor. Patrick Porter is general foreman of the contractor's forces on the day shift, and James Brown has charge in the same capacity at night.



DISCHARGE END OF CONVEYOR IS ALWAYS IN FINISHED TUNNEL—FORM CARRIAGE AT LEFT

Swiss Automatic Gates Will Guard Wissota Dam

Gates in Largest Open-Flume Hydroelectric Middle West Plant Tip Only Enough to Pass Excess Flood Waters

AUTOMATIC spillway regulation gates are a feature of a dam 60 ft. high at Wissota, Wis., now being built across the Chippewa River 3 miles above Chippewa Falls to store 8,884,000,000 cu. ft. of water over 10,000 acres of land. Energy to the extent of 45,500 hp. will be developed by the six 8500-hp. single-runner turbines, according to the December bulletin issued by the owners, and from which these notes are taken.

At the point where the dam is to be located on the Chippewa, the river runs through a bed underlain with the pre-Cambrian granites. This granite river bed has been tested by the diamond drill to a depth of from 20 to 40 ft. below the water surface, and the adequacy of the foundation has been proved. From end to end the dam and spillway which will be imposed upon this base will be 6100 ft. long. That part which runs out from the slopes of the adjacent hills to the ends of the concrete spillway will be of earth, with a concrete core wall running continuously through it. The spillway will be 900 ft. long, rising from 60 to 80 ft. above the channel which will be cut into the rock bed of the river to receive it. The dam is to be built strong enough to withstand the failure of every dam either built or contemplated upstream from its location, and this, too, at full flood.

The spillway part will be equipped with thirteen Stauwerke automatic gates, each 64 ft. long and 10½ ft. high, which will operate as the control of the flood water. These gates are of comparatively recent use in the United States, their principle being a Swiss invention, and the right to use them being controlled in the United States by the parent Swiss company.

CONSTRUCTION AND OPERATION OF GATES

The gates are hinged at the bottom and placed so as to be inclined toward the downstream side. They are supported against the water pressure by a series of steel struts on the downstream side. Each strut is fastened to one end of a balance beam, to the other end of which is fastened a counterweight. The counterweight is arranged in such a way that it is in exact equilibrium with the water pressure on the gate. As soon as the pond level rises, the equilibrium is broken and the gate starts to open. The mechanism of the gate is so sensitive that a rise of ½ in. in the pond level is sufficient to start the gate downward. The strut, balance beam and counterweight are diminished in such a way that the gate will not open totally but gradually, proportionally to the rise of the pond level.

The gate is wide open—in other words, in a horizontal position—as soon as the pond level has risen 4 in. above its normal stage. If the pond level rises only 2 in. the gate will be only half open. If the flood is only of small excess the gates will not open wholly, but descend only partly until the pond rises no more, and will close again as the flood subsides. Even with the maximum flood the rise of the pond level will be no more than 4 in. at the gate, at which rise all gates will be totally open, and the combined openings of all thirteen gates has been calculated to be enough to control a flood larger than any on record.

EARTH DAM HAS CONCRETE CORE WALL

There will be 225 ft. of concrete power station built into and made part of the dam, and 300 ft. of concrete dam from the power station to the earth embankment on its side of the river. All the rest of the dam will be of earthwork with a concrete core wall anchored in the rock from the edges and being integrally continuous from the dam itself.

From the top of the embankment to its junction with the hillside the earth embankment will have a slope of 1:4. On the downstream side the slope will be 2½:1. To provide this slope will involve the placing of 650,000 cu. yd. of earth, nearly all of which will be placed in position by a sluicing process. Besides the earth the dam will be composed of 60,000 cu. yd. of reinforced concrete, to make which will entail the consumption of 85,000 bbl. of cement and 800 tons of reinforcing steel.

When completed next January the plant will stand alone as one of the largest open-flume developments in the Middle West.

Contracts have already been entered into for the sale of the major part of the electric power to the Consumers Power Company, of St. Paul, and the Minneapolis General Electric Company. A transmission line 74 miles long of three wires weighing 6500 lb. to the mile will be constructed.

In addition to the professional resources of its own engineering organization, the American Public Utilities Company, owner, has retained the services as consulting engineer of William G. Fargo, of Jackson, Mich. The work is being done in the name of a subsidiary, the Wisconsin-Minnesota Light & Power Company.

Tables Facilitate Accuracy in Timber Beam Design

Corrections and Actual Value for True Dimensions of Sized Timber Show Errors in Usual Practice Based on Nominal Sizes

By R. C. HARDMAN
Civil Engineer, Colorado Springs, Colorado

YEARS AGO commercial lumber was manufactured and sold in full-sized dimensions, but in recent years nearly all kinds of lumber have been cut and marketed under certain definite specifications as to size and quality. These commercial sizes are in all cases smaller than the nominal dimensions, and in the case of lumber surfaced on four sides, are a great deal smaller. These deficiencies in size vary usually from ¼ to ⅝ in., although it is still possible to get full-size timber. The scant dimensions are not important factors in the large timbers, as the ratios of actual sizes to nominal sizes are large, but in the case of the small-dimension material, such as 2-in. lumber, the depreciation in strength and the increase in deflections are serious enough to require consideration.

UNIVERSAL PRACTICE ERRONEOUS

If in the application of beam-and-column formulas the actual dimensions of the timber were used, no harm would result. But the almost universal practice of calling a 2 x 6 a 2 x 6, instead of a 1⅝ x 5⅝, as it actually is, results in too large a safe load or too small a unit stress. When formulas are not used, recourse is had to tables giving safe loads. These tables, which are in nearly every handbook for engineers and architects, are based upon nominal sizes of timbers instead of actual sizes. Therefore it is necessary to apply correction factors to the results given by the tables if the true values be desired.

As the strength of a beam varies directly as bd^2, the deflection varies inversely as bd^3 and in certain column formulas the strength varies as b^4, it is seen that a decrease in b or d will have an important bearing on these values. It is true that the difference between 7½ in. and 8 in. is not great—only 6.67 per cent; but when the second, third or fourth powers are used with the same figures the differences reach proportions which must be taken into account. Thus, for a 2 x 8-in. joist the moment of inertia is 85.33 if nominal sizes are used, and but 57.13 if actual sizes are used.

CORRECTION TABLE FOR SAFE LOADS

In using the tables of safe loads on beams mentioned above, the usual method is to give the safe load for a 1-in. width of beam. For a beam of the same depth, but of another width, the tabulated result is multiplied by the width of the beam. This can be done if nominal sizes are used, as the depths are uniform. However, if an attempt be made to construct a similar table using actual sizes it will be found that confusion will follow, as a 2 x 8, for instance, does not have the same depth as a 4 x 8, and a 4 x 8 has a different depth from a 6 x 8. Therefore a load for a beam 8 in. deep and 1 in. wide could not be used for a 2 x 8, 4 x 8 or 6 x 8. For this reason the simple expedient of constructing new tables for actual dimensions is not feasible. Instead, tables of corrections must be prepared giving factors for each size of timber.

TABLE 2—FACTORS TO BE APPLIED TO TABLES OF SAFE LOADS

Nominal depth	Nominal breadth 2	4	6	8	10	12
2......	....	0.598	0.619	0.619	0.627	0.633
4......	0.667	0.744	0.770	0.783	0.790	0.795
6......	0.714	0.796	0.824	0.889	0.895	0.899
8......	0.714	0.823	0.899	0.909	0.915	0.919
10......	0.733	0.839	0.911	0.921	0.927	0.931
12......	0.746	0.850	0.918	0.929	0.934	0.939

Table 1 gives the actual sizes, sectional areas and section moduli of nominal-size timber faced one side and one edge, the dimensions being those of the Southern Yellow Pine Manufacturers' Association. While these dimensions may not be exactly the same in all cases as those adopted for other kinds of lumber, they will be near enough so that no material error will arise from their use.

Table 2 gives correction factors to be applied to tables of safe loads on wooden beams. These factors, being based solely on bd^2, may be used regardless of allowable unit stress or factor of safety. As an illustration of the use of the table, take the case of a 2 x 8-in. beam with a 10-ft. span. From a table at hand the safe load

TABLE 1—ACTUAL SIZES, SECTIONAL AREAS AND SECTION MODULI FOR COMMERCIAL LUMBER SURFACED ONE SIDE AND ONE EDGE

Nominal depth		Nominal breadth 2	4	6	8	10	12
2	Sec. Mod...	......	1.60	2.48	3.30	4.18	5.06
4	Size	1⅝ x 3⅝	3⅝ x 3⅝	......	......	......	......
	Area	5.89	13.14	20.39	27.64	34.89	42.14
	Sec. Mod...	3.56	7.94	12.32	16.70	21.08	25.46
6	Size	1⅝ x 5⅝	3⅝ x 5⅝	5⅝ x 5⅝	......	......	......
	Area	9.14	20.39	31.64	44.56	56.06	67.56
	Sec. Mod...	8.57	19.12	29.66	42.70	53.72	64.74
8	Size	1⅝ x 7½	3⅝ x 7⅝	5¾ x 7¾	7¾ x 7¾	......	......
	Area	12.19	27.64	44.56	60.06	75.56	91.06
	Sec. Mod...	15.24	35.12	57.56	77.58	97.6	117.6
10	Size	1⅝ x 9½	3⅝ x 9⅝	5¾ x 9¾	7¾ x 9¾	9¾ x 9¾	......
	Area	15.44	34.89	56.06	75.56	95.06	114.6
	Sec. Mod...	24.44	55.97	91.10	121.8	154.5	186.2
12	Size	1⅝ x 11½	3⅝ x 11⅝	5¾ x 11¾	7¾ x 11¾	9¾ x 11¾	11¾ x 11¾
	Area	18.69	42.14	67.56	91.06	114.6	138.1
	Sec. Mod...	35.80	81.65	132.3	178.3	224.3	270.4

on this beam is shown to be 1706 lb. From Table 2 the correction factor to be applied for a 2 x 8 is 0.714. Applying this to 1706 gives 1218 lb.—nearly 500 lb. less than shown for the nominal size.

CHANGE IN DEFLECTION

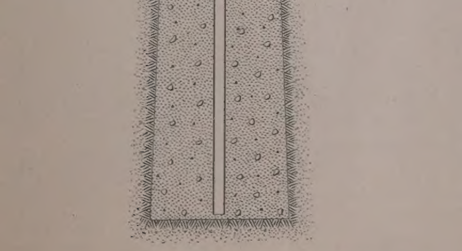
If the factors in Table 2 have been applied, the change in deflection from that computed for the nominal sizes will be almost negligible, except in cases where the depth of the beam is less than the breadth, which is seldom true. Moreover, as the modulus of elasticity, which enters into the computation for deflection, is very indefinite for wood, these corrections may be omitted.

From the above tables, which are based on material surfaced on one side and one edge only, it will be seen that the influence of the scant dimensions on safe loads varies from 59.8 per cent to 93.9 per cent. Similar variations will be found in the case of columns. For instance, a 4 x 4-in. column 10 ft. long, computed by Rankine's formula, gives but 70 per cent of the strength of a full-sized column of the same dimensions.

It may seem that the application of these factors is an unnecessary refinement. This is true, possibly, in the case of the larger sizes, where the correction factor is more than 0.9, but is certainly not true for the smaller sizes. Even though the strength of timber is variable, it seems reasonable in safe and economical designing to apply the factors given, especially when the loads for nominal-sized timbers are from 10 to 50 per cent in excess of the loads safely carried by actual-sized timbers.

Offset Street Monuments 10 Feet from Intersections

STREET MONUMENTS in El Paso, Tex., are placed 10 ft. north and east from the street intersection, thus making them accessible and still out of the way of street-car traffic. The monument consists of a concrete post 3 ft. deep, 12 in. in diameter at the base and 9 in. at the top, set in a hole dug with a post-hole auger. A 1-in. galvanized iron pipe set in the center of the concrete carries a brass plug at the upper end. The pipe also acts to reinforce the concrete. The center of the cross on the plug is accurately set and the elevation recorded, so that both line and grade are available.



FRAME AND COVER ARE INDEPENDENT OF MONUMENT

The method of building the cover into the pavement, so as to make it entirely independent of the monument, is shown in the accompanying drawing. The monuments cost about $35 each.

Competitive Examination Should Govern Highway Appointments

L. W. Page Would Eliminate Politics from Road Work and Save $50,000,000 Which Is Now Wasted Annually

ASSERTING that $50,000,000 is wasted annually in road-building and maintenance by incompetent officials, and that there are, in the whole United States today, only 150,000 miles of really first-class public highways, Logan Waller Page, director of the U. S. Office of Public Roads and Rural Engineering, in an address before the American Association for the Advancement of Science, forcefully denounced the practice of making political expediency the basis of appointment to positions, and urged control of state highway departments by non-partisan, non-paid commissions of laymen selecting technical officers only after their fitness has been demonstrated by competitive examinations.

$50,000,000 WASTED ANNUALLY

"The day for road administration under men holding office solely upon their merit has arrived," said Mr. Page. "We do not want men chosen because of their value as political workers, but men noted for their constructive gifts and proved engineering ability. What difference does it make to the farmer hauling his crops to market, or to the merchant transporting his merchandise home, or to the traveler journeying from place to place, whether the road was built and is maintained by a Democrat or a Republican or a Progressive? The road is the thing. Yet, speaking generally and of the country at large, road construction and road maintenance have been largely committed to more or less desirable political workers with the result that not less than $50,000,000 is wasted annually by the carelessness and incompetence of the men charged with the supervision and administration of the public highways of the country. It is not so much the fault of the road officials themselves—they want the money wasted upon them in the way of salary, and need it—but of the political system which makes their selection possible. Before there can be any substantial improvement in the character and efficiency of the men the system must be destroyed."

"There are in the United States 3000 counties and approximately 100,000 local road officials, supervisors who do not know how to supervise, overseers who lack both the technical knowledge and administrative ability to oversee, insufficiently paid for competent work but overpaid at any price for what they can do, and who are elected by the people because they are 'good fellows.' They are hard workers in party affairs, and they must have 'recognition,' bother the roads and the purposes for which they are opened. Time was not so very long ago when in some of the states superintendents of education, who signed their names with a cross mark, were not infrequently selected, because they had been 'good soldiers' and needed the salary. If the public roads of the country are to be accepted as proof of the fitness of the road officers they are condemned by their work."

CHANGES IN OFFICE CAUSED BY POLITICS

The whole business has been running at loose ends, according to Mr. Page. What should have been everybody's business has been nobody's business. There has been no continuity of effort, no organization of the working units, no general planning in the public interest, no seat of authority, no care in administration. Changes in the political control of states and counties and districts are followed by changes in the political complexion of road officials, without regard to the competency of the new men selected for this work or the efficiency and experience of the men displaced to make a political holiday. Within the last ten years arbitrary changes on political grounds have been made in the control of the engineering work in the state highway departments of Arizona, Connecticut, Delaware, Maine, Michigan, Maryland, Missouri, New Hampshire, New Jersey, New York, Pennsylvania, Washington and West Virginia. In the last fifteen years nine changes have been made in the control of the highway department of New York, and the most of these changes have been made on partisan political grounds. Doubtless some of the changes have been justified because of the inefficiency or other unfitness of the men holding office; but in the main the highway departments have been regarded as offering convenient refuges for "deserving" workers in whatever party happens to be on top.

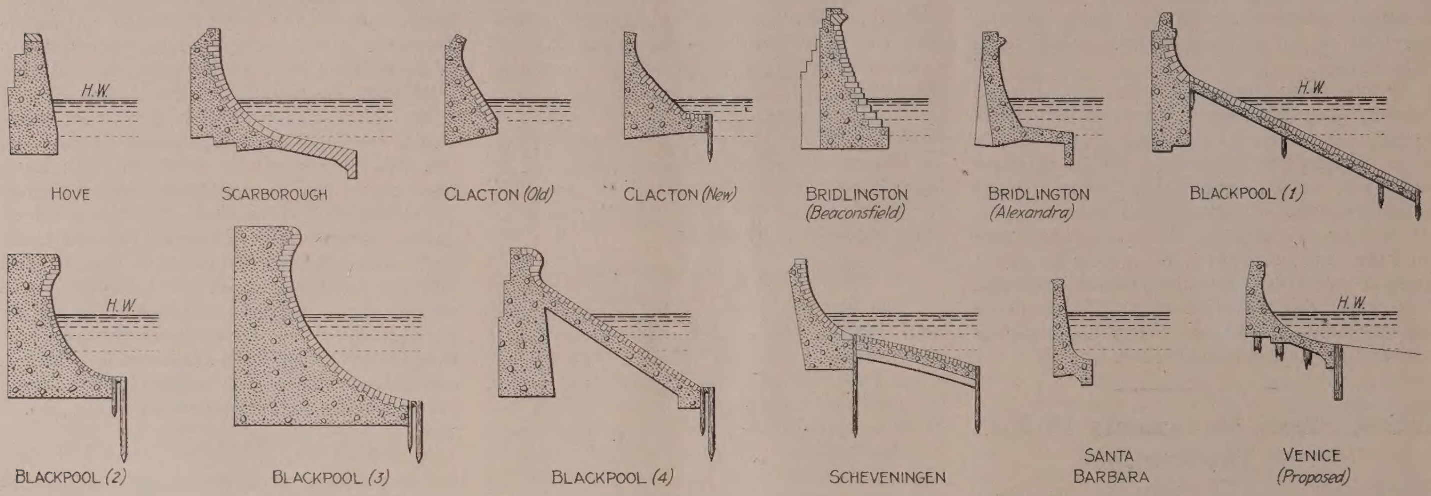
COMPETITIVE EXAMINATION URGED

The building of public roads ought to be a purely business enterprise, managed on strictly business principles. The men charged with the work should be selected solely on the ground of merit. As the most effective way of protecting the state highway departments from the destructive influence of partisan politics Mr. Page suggests that each department be placed under the control of a non-partisan, unpaid commission, partly ex-officio and partly appointed, and representative of the education and scientific institutions of the respective states, the appointed members of the commissions to be selected exclusively from laymen of approved fitness for the work in hand. He would entrust to these commissions the selection of the chief technical road officers, their selection to be made wholly on the ground of qualifications as proved by competitive examination, just as the officers of the Government at Washington are selected for their fitness. He would take the roads of the country out of politics, the bane of all well-directed and successful administration of the most important service. He would not interfere with the initiative and voice of the counties in the management of their local affairs further than to require that the men selected to direct the country road work should be chosen only after passing such examination as the state highway departments, acting in co-operation with the civil service department of the state, might require. The intelligent application of the merit system in securing skilled supervision in road work is the only promising method of eliminating politics from road administration.

Sea Walls of Various Designs Discussed and Compared

Success or Failure of Many Types Have Shown Curved Faces and Long Toes to Be Among the Essential Features

SEA WALLS and groins are in general mutually supplementary in the protection of sandy seashores, as was pointed out by Leeds & Barnard, engineers, of Los Angeles, in their report on the problem at Venice, Cal., which was abstracted in the Engineering Record of Jan. 8, page 51. Some of the latest developments in groin work along the coast of Holland were described in last week's issue, page 118. A discussion of various types of sea walls built at various times and places, mainly along the English coast, was included in the Leeds & Barnard report, and is here presented. The last drawing is that of the wall proposed at Venice, and the discussion by the authors as it appeared in the abstract published Jan. 8 is here repeated for convenience.



MANY TYPES OF SEA WALL HAVE BEEN TRIED, ESPECIALLY ALONG THE SOUTH AND EAST COASTS OF ENGLAND

Examples of Sea Walls

Of sea walls there are many different types, and the accompanying cross-sections show a number of the more important ones. A brief description of each follows. It is to be remembered that the costs as given represent work done under conditions very dissimilar to those prevailing in this locality at the present time. Such walls if constructed here would cost a very much greater amount.

Hove Sea Wall.—Built in 1884, of concrete, faced with 4-in. flints. Within a year after construction the sea scoured out the beach 7 or 8 ft., to within 10 in. of the bottom of the wall, necessitating the driving of sheet piling. This is a good illustration of the scour which usually occurs in front of a nearly vertical wall. Cost unknown. Groins were later constructed in this instance and have since maintained the beach in front of the wall.

Scarborough.—The section not cross-hatched was built in 1886-90. It was set 2 ft. in hard shale. It was subject to heavy wave action which soon after completion scoured out the beach and cut out the shale in places to a depth of 3 ft. The apron shown cross-hatched was added in 1891. This apron consists of pitched stones on a layer of concrete. The cost, including backfilling but not the added apron, was approximately $26 per linear foot.

Clacton (Old Wall).—This was built about 1880-2. It was founded in London clay. The cutting effect of the waves was largely due to three high concrete groins, so great that the groins had to be removed and an apron added to stop the scour and prevent overturning of the wall.

Clacton (New Wall).—As a result of the experience with the old wall this wall has an apron added, and a slightly flatter slope. Cost about $30.50 per linear foot.

Bridlington - Beaconsfield.—This was built in 1888. It is stone faced with concrete backing. Cost approximately $49 per linear foot.

Bridlington-Alexandra.—This was built in 1879 at a cost of approximately $27.75 per linear foot.

Blackpool (1).—This consists of a wall proper with an elaborately protected slope in front. The slope protection is at an inclination of 2:1, and has a tendency to encourage scour. It has had to be extended as the beach lowered. Three quarters of a mile of this protection, including a promenade, cost $575,000, or $145 per linear foot.

Blackpool (2) *and* (3).—These walls have been built very recently and represent probably the result of previous experience. The massive construction, curved face to receive and reflect the waves, protected surface in the rear of the wall and protective sheet piling at the toe are all to be noted.

Blackpool (4).—This wall is the last one constructed and shows the retaining-wall section with long sloping rock-faced apron. The total cost of 1200 ft. of the latter type, and 8352 ft. of types (2) and (3) was $1,850,000. This gives an apparent cost of approximately $190 per linear foot.

Scheveningen.—This is another combination of sea wall and slope protection. It was built about 1896-97. It is of concrete, faced with basalt blocks. Cost approximately $60.20 per linear foot.

Santa Barbara.—Built in 1915. This wall has not been in long enough use to have been subjected to any very severe test. This is a much lighter type of wall than the foreign walls described above, but is not exposed to such severe wave action. It is designed as a reinforced structure and not as one having a gravity section. The design embodies a number of correct principles, and presumably the size and weight of the wall are designed in accordance with the exposure, beach conditions, etc. Its cost was about $35 per linear foot.

Coronado.—This [not shown] is a sea wall of the random rock type used to protect the properties and driveway along the ocean front. It protects a light concrete wall in its rear, which in turn retains the roadway along the beach. It is a good example of a flexible, permanent and substantial type of protection, and occupies no great amount of beach space. If any settlement occurs due to an unusually hard storm, a little more stone can be added on top and the wall is stronger and better than before, and no labor or material will have been wasted. Concrete slab steps can be cast for access to the beach, and absolute protection to property is assured.

Wall Proposed at Venice, California

The proposed concrete wall at Venice embodies the best principles of sea-wall design. It has an elliptically curved face, which is the natural form of the wave, and is therefore best suited to changing the motion of the water from horizontal to vertical. At the bottom the curve is tangent to the slope of the beach. It therefore guides the wave from the beach to the wall and vice versa with the least possible disturbance.

Above the curve the wall slopes slightly backward, but has a slight coping at the top, just sufficient to prevent the wave being thrown upon the promenade back of the wall. This coping is carefully designed to turn the wave so that it shall fall on the apron, rather than on the beach in front of the wall. Scour of the beach at the toe of the wall will therefore be eliminated. To prevent undermining of the wall by a lowering of the beach in any exceptional storm, the sheet piling necessary during construction will be cut off at the toe and left in place.

The mass of the concrete is so distributed as to place the greatest resistance where the waves will strike with the greatest violence. It also offers the maximum resistance to the sand pressure from the back. Under present conditions such a wall should cost about $50 per linear foot.

MAINTENANCE OF A CONCRETE ROAD on Superior Boulevard carrying the heaviest traffic between Minneapolis and Lake Minnetonka cost $9.32 per mile last year. The original cost of the 4.8-mile stretch was $68,062. On the same road are 3.8 miles of macadam one year older than the concrete. It cost for maintenance $280 per mile per year, and $50,000 total to build.

Hydraulic Ejectors for Grit Removal Merit Trial in Sewer Maintenance

Tests Needed to Demonstrate Further Possibilities of Catch-Basin Cleaning by New Method Adopted in City of Seattle

By JOHN H. GREGORY
Consulting Engineer and Sanitary Expert, New York City

HYDRAULIC ejectors for cleaning sewer catch-basins at Seattle, Wash., described by A. W. Howard, of the city engineer's office, in the Engineering Record of Dec. 4, 1915, page 690, are well worth careful study by engineers in charge of the maintenance of sewer systems where grit must be removed from catch-basins or other devices serving the same purpose. The hydraulic ejector for raising and transporting sand has been used for a good many years, but Seattle is one of the first, if not the first, city to employ a hydraulic ejector for removing grit in connection with the maintenance of a sewerage system, although the idea of using an ejector for this purpose is not new. To the writer's personal knowledge it received serious consideration at least twice, once in Columbus, Ohio, in 1908, and again on the Passaic Valley sewerage project in New Jersey in 1909.

EJECTORS CONSIDERED AT COLUMBUS

In Columbus a large part of the city is sewered on the combined system, the dry weather flow being intercepted and discharged into an intercepting sewer which leads to a pumping station from which the sewage is pumped to the disposal works for treatment. The intercepting sewer, in a number of stretches, has quite flat grades with resulting low velocities, in several places the velocity being less than 2 ft. per second, while in one stretch the velocity is as low as 1.72 ft. per second. Trouble has been experienced a number of times from the deposit of grit in this sewer, and the removal of the grit has been expensive. This condition of affairs came to the attention of the writer while he was in charge of the design and construction of the sewage disposal works at Columbus, and he gave serious consideration to the construction of catch-basins and sand-catchers at the junction of certain of the lateral combined sewers with the intercepting sewer for the purpose of preventing a part, at least, of the grit from entering the intercepting sewer. The construction of these proposed sand-catchers was referred to by Julian Griggs, former city engineer of Columbus, and also by the writer, in the discussion of a paper descriptive of the Columbus sewage works. (*Transactions*, Am. Soc. C. E., Vol. 67, pages 206-437, "The Improved Water and Sewage Works of Columbus, Ohio," by John H. Gregory.)

Although no mention was made in the writer's discussion of any method of removing grit from these sand-catchers, he had in mind, from a wide experience with the handling of sand by hydraulic ejectors, the use of an ejector, the principle of which, if not the detail, was the same as that in use in Seattle. Unfortunately, funds were tied up until the completion of certain contracts, and it was not until the sewage disposal works were nearly completed that funds were in sight to make a start on the carrying out of this work. Realizing that this work should be done, and also that the writer's connection with the city would shortly come to an end, he made the recommendation that one of his assistants be retained to design these connections and supervise their construction, but no action was taken on this recommendation.

PASSAIC VALLEY PLANS

In the following year, 1909, while resident engineer of the Passaic Valley sewerage project, the writer again gave consideration to the use of the hydraulic ejector for removing grit from proposed sand-catchers or catch-basins which were to be so located as to prevent the heavier grit, which would come from certain lateral combined sewers, from entering the Passaic Valley sewer. The writer proceeded a little further with the idea this time, and he had made, before severing his connection with this work in 1910, quite a number of studies and detail designs of intercepting connections in which a sand-catcher for removing grit was included, the grit to be removed by a hydraulic ejector. And he even went so far, personally, as to make some rough tentative sketches of a specially designed motor-operated wagon or truck adapted for use with such an ejector.

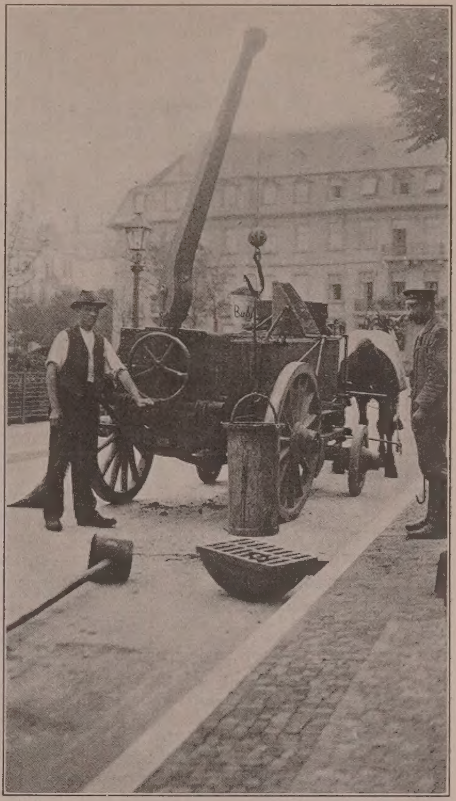


FIG. 2—CRANE RAISING CATCH-BASIN BUCKET FILLED WITH GRIT

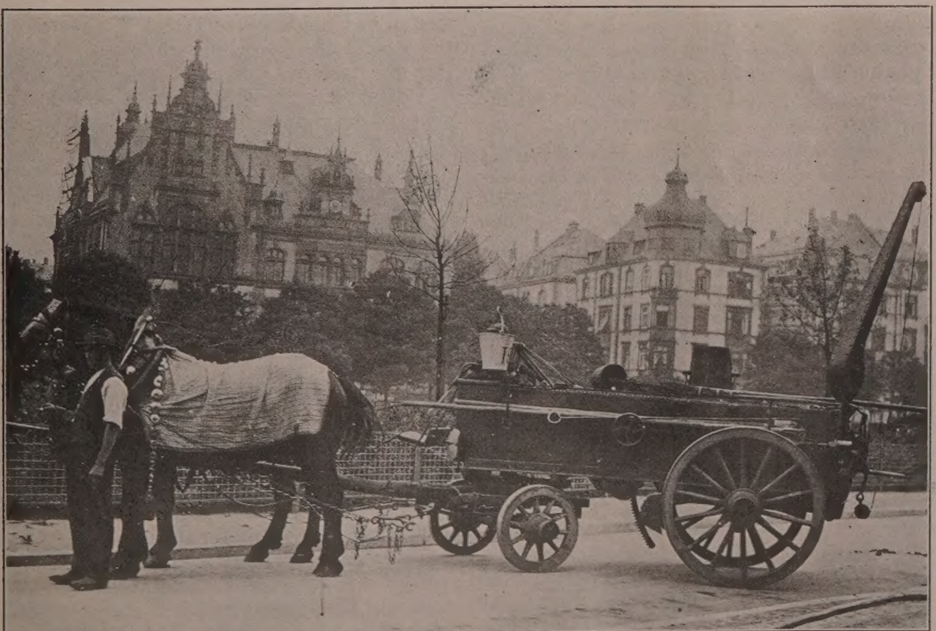


FIG. 1—IN FRANKFORT, GERMANY, SPECIALLY DESIGNED WAGONS ARE USED IN THE WORK OF CLEANING CATCH-BASINS

EJECTOR TESTS NEEDED

The writer does not wish, for a moment, to convey the idea that the hydraulic ejector will, by any means, solve all of the troubles and annoyances encountered in removing grit in the maintenance of a sewerage system, and he realizes full well that the ejector has its limitations, but in his opinion the idea of using such an ejector has enough merit to warrant, in large cities, the expenditure of sufficient funds to determine, on a practical scale, the relative advantages and disadvantages of the ejector for removing grit from sewer catch-basins.

Where grit is retained in what are now generally termed grit chambers, it is questionable how far the ejector could be used to advantage, especially in large grit chambers. But where it is desired to keep grit out of sewers which, perforce, have been or must be laid on relatively flat grades, the construction of sand-catchers at suitable points, and the removal of the grit therefrom by hydraulic ejectors, may be of material assistance in helping to keep the sewers free from objectionable deposits and thereby to reduce the cost of maintenance.

No hard and fast rules can be laid down as to whether the best results would be obtained with a stationary or portable ejector, as local conditions would generally be a controlling factor in deciding which type to use. The hydraulic ejector might be of much service in removing grit from catch-basins which are so commonly built for storm water to pass through before entering the sewers, and here again the feasibility of removing grit by this means is well worth trying out on a practical scale. Such an investigation should, however, be carried on under the direction of one who will appreciate in advance that troubles with the ejector are sure to be encountered sooner or later, and that much patience may be needed in order to overcome them.

Danger of Clogging

It is well known that nearly everything under the sun is either thrown, or in some other way gets, into the streets and that much of such matter is washed into the catch-basins, where a portion of it is retained. Not all of the material retained in the catch-basins can be handled by a hydraulic ejector, and it is fairly safe to predict that clogging of the ejector would, at times, take place. Whether the clogging would occur frequently enough to cause this method of removing grit to be more of a nuisance than a convenience can only be determined from actual experience. It is, however, possible that the ejector could be used to advantage in cleaning out a part of the material only from the catch-basins, as grit, sand, etc., thereby reducing the amount to be removed by other means.

The character of the pavements would have a direct bearing on the nature of the material retained in the catch-basins. Thus, in one locality, the streets may be well paved, in which case perhaps but relatively little grit would find its way into the catch-basins, while in another locality there may be many unimproved or macadam streets, in which case the catch-basins would be likely to receive a considerable amount of grit. Again, the material which had accumulated in the catch-basins in one locality might be so light that when removed by an ejector and brought into suspension in water it would not readily settle out in passing through either a movable or stationary tank especially built for the purpose of retaining such material.

The problem of cleaning catch-basins by means of a hydraulic ejector would not be fully solved with simply the removal of the material from the catch-basins. There still remains to be handled the mixture of water and material as discharged by the ejector. If the catch-basin material is heavy grit or sand, it would readily settle out in passing through a tank in which the velocity would be materially checked. Such a tank could, to advantage, be mounted on a specially designed motor truck, the truck to serve a double purpose, first, of providing means for the settling out of the material ejected from the catch-basins; and, second, of providing means for transporting this material to the point of disposal. The dirty overflow water from the tank, depending on local conditions, as on the grade of the gutter and on the order in which the catch-basins were cleaned, might be either discharged into the gutter, from which it would find its way to the sewer, or piped direct into the sewer.

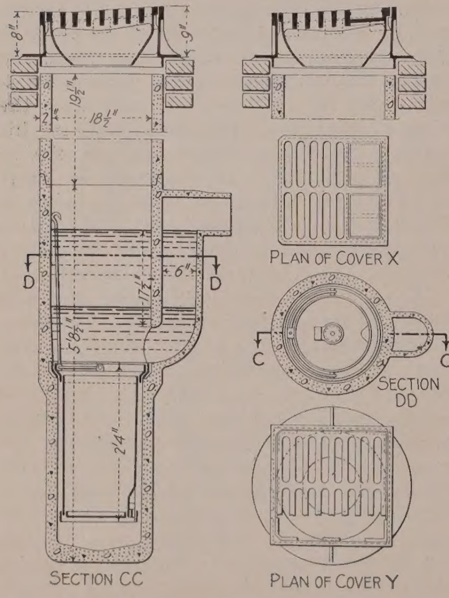


FIG. 3—TRAPPED CATCH-BASIN WITH DEEP HANGING BUCKET

Tank Truck an Accessory

The idea which the writer has had of a specially designed truck seems to coincide, in certain particulars at least, with the proposed wagon which Mr. Howard has planned to use in Seattle. For catch-basin service, however, the writer would go further than simply providing a truck with a tank for the settling out and transportation of the heavy material. The truck could, to advantage, be fitted up so as to carry an ejector which could be lowered, direct from the truck, down into the catch-basin, and also so as to carry the hose necessary to connect the ejector with the nearest hydrant and to carry away the dirty overflow water, if it was not found satisfactory or practicable to discharge it into the gutter. Means could also be provided for rolling up the hose and for carrying such tools as it would be found necessary to use.

It might, perhaps, be better to have one truck, an ejector truck, fitted up especially for handling the ejector operations, and other trucks, tank trucks, which could be provided at less expense, fitted up with tanks for the settling out and transportation of the material. One specially designed ejector truck could then, perhaps, keep several tank trucks busy with a minimum loss of time. That specially designed trucks or wagons fitted up for catch-basin cleaning can be used to advantage and that economy of operation will thereby result, has been shown by the experience in several cities, as for example in Pawtucket, R. I. (see Engineering Record Jan. 24, 1914, page 111), where a motor truck with an orange-peel bucket and boom is used not only for cleaning catch-basins but for transporting the material removed therefrom. It is obvious, of course, that the truck must be designed especially for the class of work which it is called on to perform.

Special Wagon Used in Germany

One of the best of these specially designed wagons is the one used in Frankfort, Germany, which the writer first saw there several years ago. Two views of one of these wagons are shown in Figs. 1 and 2. The construction and operation of the wagon will be readily understood from an examination of the photographs, especially of Fig. 2, which shows the crane raising a catch-basin bucket filled with grit. The bucket is raised to the top of the wagon where it is set upright in a pivoted tipping tray which may be seen on the right-hand side of the wagon. The tipping tray and the bucket are then turned over to the left, counter-clockwise, the bucket discharging its contents into the wagon.

Two Types of Catch-Basins

Two types of catch-basins are in use on the combined sewers and storm water drains in Frankfort. The first type, Fig. 3, is trapped and has a deep-hanging grit bucket; the other type, Fig. 4, is not trapped and the grit bucket is suspended at the top of the catch-basin. It will be noted that the Frankfort catch-basins are much smaller than those ordinarily built in American cities.

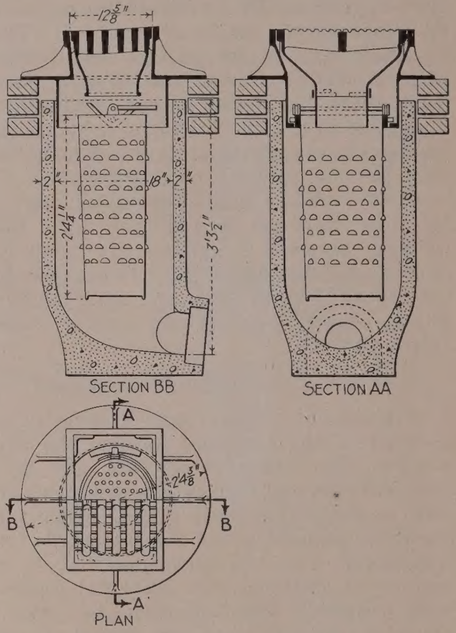


FIG. 4—UNTRAPPED CATCH-BASIN WITH BUCKET NEAR TOP

It should not be inferred that the use of a hydraulic ejector for catch-basin cleaning is necessarily the best method, or that it is applicable under all conditions. The method has sufficient merit, however, to warrant a fair trial on a practical scale, and only by so doing can its advantages and its shortcomings be determined. The writer has made no secret of his views on the use of the hydraulic ejector for cleaning catch-basins and sand-catchers, as he has discussed the subject with various engineers ever since he first proposed to use this method in Columbus, in 1908, and it is a source of much satisfaction that other engineers, acting entirely independently, have had sufficient faith in the method to install it on a practical scale and give it a fair trial. Too much credit cannot be given the engineers of Seattle for the work they have done in furthering the use of the ejector.

A **Bithulithic Pavement**, laid with soft stone, in Houston, Tex., was recently resurfaced. The soft material had begun to break out and some attention was necessary. The surface was thoroughly cleaned and cut back with Texaco asphalt cement (60 penetration) and naphtha. This was squeegeed on and left for about two hours until the naphtha had evaporated. The surface was then covered with a coat of asphalt cement and ¼-in. chats. This has, the city engineer of Houston, E. E. Sands, reports, proved a satisfactory method of treatment.

STACKS OF SHELLS BUILT UP WITH CLOSE ALIGNMENT ON CURVE AT BASIN 1

Large Volume of Concrete Handled in Small Batches at Halifax Ocean Terminals

Great Accuracy in Casting 62-Ton Blocks Laid Under Water on Foundations Prepared by Diving Bell—Unusual Drilling and Dredging Equipment

THAT submarine foundation walls for piers and quays can be built up in open water from solid rock with concrete blocks, securing first-class results in both grade and alignment, is being proved by the contractors for the first unit of the ocean terminals at Halifax, Nova Scotia. All the expense of cofferdams, or of rows of pneumatic caissons, is eliminated. The concrete is cast on shore in plain sight or is placed under water in most favorable circumstances by economical methods. The rock excavation is being done cheaply and at a rapid rate.

Unusual Conditions

But the foundation walls are no ordinary walls. Most of the blocks, or "shells," of which they are built weigh upward of 62 tons apiece. And the submarine excavation is no ordinary rock contract. More than 300,000 yd. of solid schist must be drilled, blasted and dredged to a depth of 45 ft. below low tide to make room for the land side of the pier, quay and basin now under construction. So also the plant assembled for the job does not consist altogether of the ordinary construction tools. It includes a central concrete plant capable of mixing more than 1000 yd. of concrete in twenty-four hours, and of mixing it in small batches that can be dumped into the accurately-adjusted shell forms without danger of displacing them. It includes a 310-ton tool resembling the giant shovels used for stripping in the western coal fields, but equipped with a steel boom and 5-yd. orange-peel, and mounted on a 180-ft. scow. It includes a 12½-yd. dipper dredge, two other smaller dredges and two drill scows capable of drilling simultaneously seventeen holes. These last are equipped to load holes, move back and fire the shot, and move up again and resume drilling, without assistance and in a very short time. The plant includes also a large diving bell in use for placing the concrete stools or pedestals under the corners of each stack of shells, which make it possible to lay them exactly level. A derrick barge which also mounts boiler, compressor and concrete plants, attends the diving bell. Besides, a floating concrete plant has been made ready for special work.

On shore the concrete buckets are handled by two locomotives and low, standard-gage flat cars, and dumped by an Industrial locomotive crane. Another crane of the same make, of 150 tons capacity, handles and places the huge shells at any radius up to 33 ft. In addition a granite quarry has been developed at Purcell's Cove, down the harbor, for rubble and face stone. A fleet of barges and three harbor tugs are used both to transport this material and to bring in sand and gravel from across the bay.

How Wall Is Placed

The principle on which the construction plan is based consists of building up a wall 31 ft. thick of the shells shown in the accompanying illustrations. The wall to be completed under the present contract will extend around the site of pier A, basin 1, and the passenger landing quay. The blocks are laid on top of each other by the locomotive crane running on the finished wall after the excavation has been completed and the foundation prepared with the diving bell. When a stack has been completed all the holes in the bottom shell and for half the height of the next-to-the-bottom shell are filled with concrete deposited under water. The rectangular holes down the center of the stack and across the outer face are then concreted solid, making a solid face on the water side with a counterfort at the center of every stack. The holes with round ends and the spaces between stacks are then backfilled with rubble and dirt. The small 10-in. holes are then grouted, all voids in the horizontal planes between shells being filled. In some of the latter holes old rails are hung from top to bottom to help bond the stack together. The V-shaped notches at each corner of the shells fit around square concrete posts, which are placed at the same time as the shells, and form a guide for setting them, as well as keying adjacent stacks together.

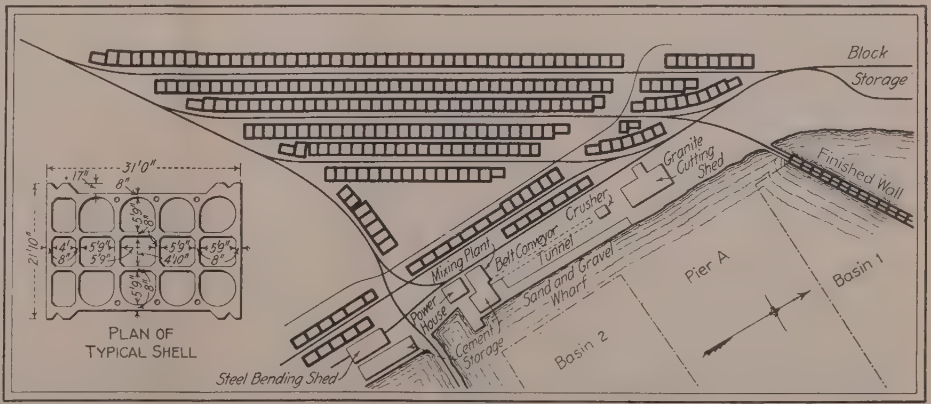
Part of the quay wall and the outer end of the pier lie in water 60 ft. deep. Of course no excavation for the basin was required at that depth, and rather than spend money to step off the bottom and build a wall of additional height and thickness, rubble mounds will be built up to 45 ft. below low water, allowed to settle for a year, leveled off and used in the same way as the rock bottom as a foundation for the wall.

Behind the quay and inside the pier a fill will be placed, of material dredged from the site or hauled from a heavy cut on the railroad being built to the terminal. This will give the wall a heavy backing of riprap.

On the shelf formed by stepping back the top two shells of each stack will be built a face wall of cut granite, backed with a heavy section of concrete. The wall will then be ready for final filling, which, as will be remembered from the article on page 102 of the Engineering Record of last week, will be of sand and gravel.

Block Casting a Critical Factor

How to build such a wall with economy and speed was the problem confronting the contractor. It has been found that a stack of these shells 44 ft. high, containing 322 cu. yd. of concrete, could be set in less than three hours. Granted that the drill boats and dredges could keep out of the way with the general excavation, the diving bell could prepare the foundation for a stack in about forty-eight hours. This speed, however, might be increased to the preparing of foundations for three stacks in the same or a shorter length of time, which, it is estimated, could be done with a new diving bell, the construction of which is now being considered. Should the proposed new and the existing bells both be used, a speed of three stacks a day could be reached by one crane. With the present and proposed diving bells and stacks of



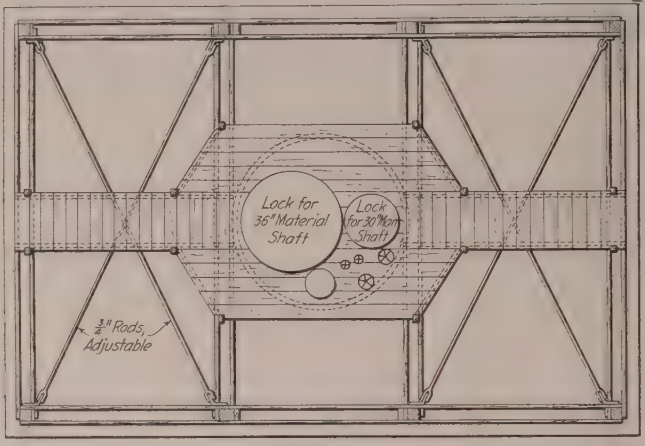
ENOUGH CASTING PLATFORMS PROVIDED FOR 7500-YARD RUN WITHOUT SHIFTING the height composing the bulk of the work, 1150 yd. of shells could be set per day, and 1050 yd. of additional concrete placed in the pockets. It was decided to build a concrete plant capable of at least maintaining the rate required to concrete the pockets, and in addition to cast as large a supply of blocks in advance as possible, to guard against delay from cold weather, shortage of material, or breakdowns.

As it was necessary to let the blocks set 28 days before they could be handled, a yard containing upward of 260 form platforms, arranged along six tracks, was laid out. This made possible a continuous run of more than 7500 yd. without the necessity of moving any of the blocks. In order to keep up the work at this rate, thirty-four forms were provided for the shells S-1, of which 2453 are to be made. Forms for the shells S-4, of which there are 462, and for shells S-2 and S-3, of which there are 264 each, were ordered in proportion. The forms, shown in the accompanying photographs, were of Blaw design. The outside forms for special shells, of which there were few to be cast, were made of wood. It has never been necessary to cast any of the blocks on top of each other with building paper between, as was at first intended, to increase the capacity of the casting yard. This system would have made the handling of the forms much more expensive.

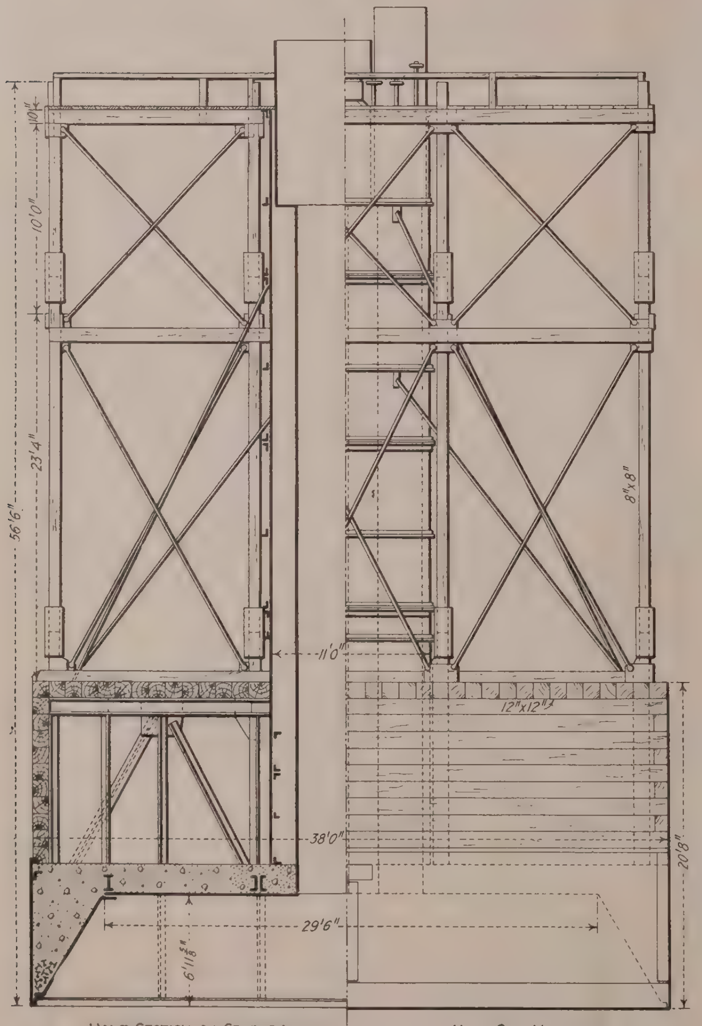
When possible the blocks are taken direct from the molding yard and placed in the wall. It is necessary, however, to store the surplus blocks for winter use before they are placed, for which two tracks northeast of the casting yard and in line with it are provided. Each block is stenciled as soon as the forms are removed with its date, its serial number in the order cast, and its pattern number. Shells of the same pattern and approximately the same age are stacked on top of each other three or four deep in the storage yard. Already about 1200 of the 3667 shells needed have been cast, which gives ample margin for the winter's setting and will leave something to work with when weather conditions permit the resumption of open-air casting.

Form-Setting Accurately Done

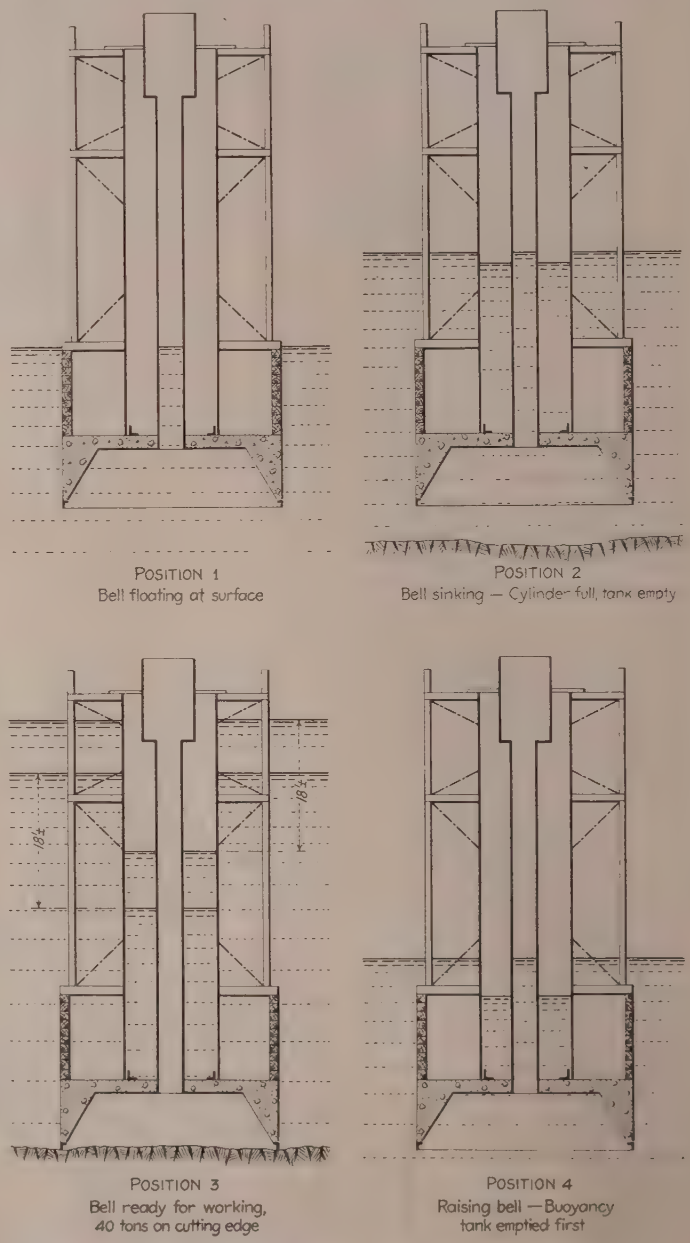
The platforms on which the blocks are cast must be carefully leveled each time the forms are set. The slightest irregularity in the principal dimensions or "square" of the blocks would make laying difficult. Holes are cut in the platforms under each pocket in the shells for which they were made to give access to the leveling wedges. The steel pocket-forms are assembled first and the reinforcing is placed, after which the outside form is set up, the platform is leveled and the forms are carefully adjusted. The reinforcing is all handled and bent in a special shop equipped with circle bending rolls and hook benders. Most of the bars are 7/8 in. square or less. About six men are kept busy in the shop continuously.



Top View



Half Section on Center Line Half Side View



Position 1
Bell floating at surface

Position 2
Bell sinking — Cylinder full, tank empty

Position 3
Bell ready for working, 40 tons on cutting edge

Position 4
Raising bell — Buoyancy tank emptied first

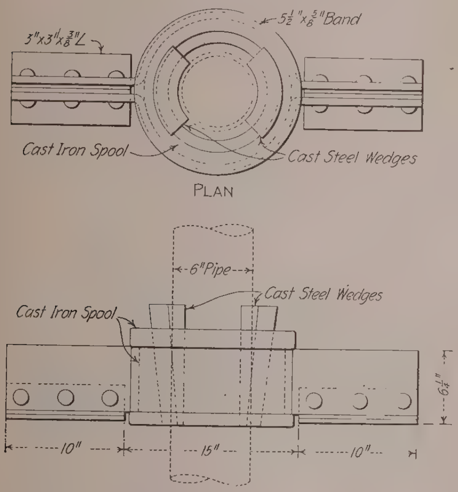
DIVING BELL HAS BALLAST TANK DESIGNED TO FACILITATE RAPID MOVING FROM ONE PAIR OF FOUNDATION STOOLS TO NEXT

Small board platforms fitted over the top of each pocket or cell of the forms provide a platform for the men and for dumping the concrete. It is apparent that the impact of even a yard of concrete, unless carefully dumped, would throw the form out of level. Therefore ½-yd. batches were decided on. These were found to be unnecessarily small, and this winter longer drums are to be placed in the four Ransome mixers at the central plant to increase their capacity to ¾-yd. batches. This size batch, also, is nearly as large as the under-water concrete buckets used to fill the cells could be designed to hold without danger of tipping and wedging when being raised.

STEEL FORMS AND SOLID LEVEL PLATFORMS MAKE ACCURATE CASTING POSSIBLE

CENTRAL CONCRETE PLANT

The concrete plant, thus, instead of the 2 or 2½-yd. mixers usually associated with a 250,000-yd. contract, consists of four small units. These face the loading track and dump directly into buckets on the low flat cars used. Over them are the storage bins, loaded from the screening plant, which is fed by bucket conveyors. Sand and gravel are handled to this conveyor from barges or storage by a clamshell traveler derrick. The material received contains many large stones, which are returned to jaw crushers from the screens to be broken up. It was feared that too great an excess of sand would be found in the material, and an additional crusher plant was set up at the far end of the storage pile to provide crushed rock for adjusting the mix. In this plant the rock brought in on scows is dumped by derrick into the hoppers feeding the crushers. The crushed rock is elevated to the storage pile, and taken to the concrete plant by a belt conveyor boxed in under the storage pile. The roof of the tunnel through which this conveyor runs is provided at intervals with spouts drawing material from the bottom of the pile.



CLAMPS HOLD CASINGS PULLED BY RAISING DRILL BOAT ON ITS SPUDS

HOW CONCRETING IS DONE

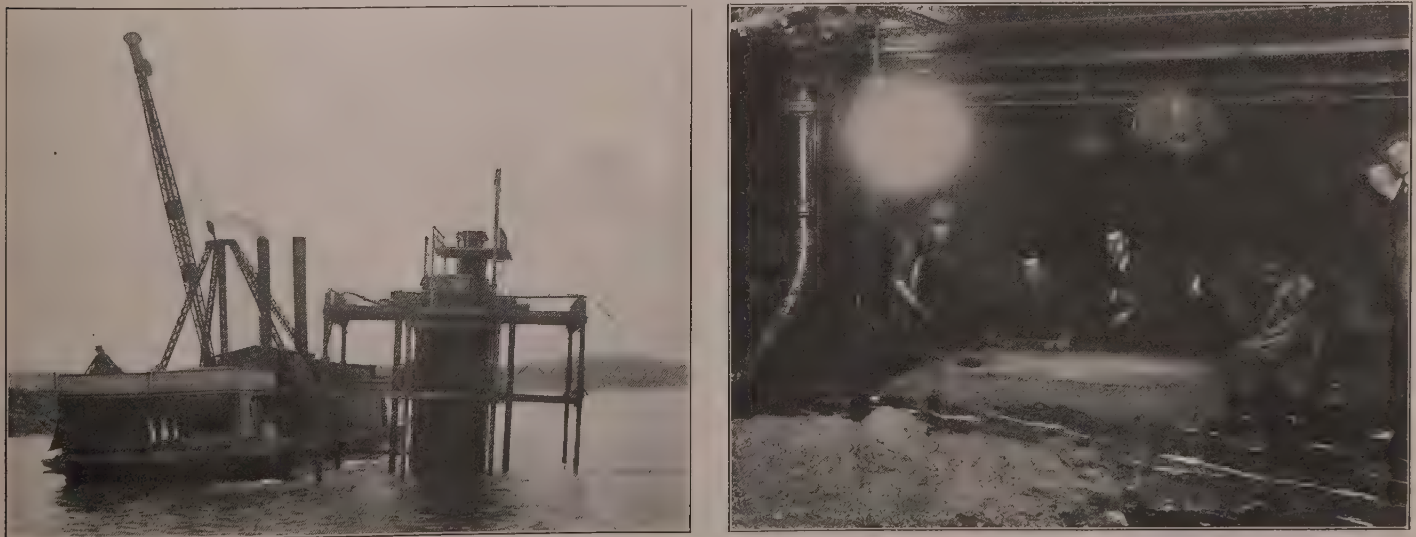
At present the plant is being run days on casting blocks and nights on filling pockets in the completed stacks. The latter work is done with two-bail, single-line buckets, which dump when picked by the lower bail. The double doors in the bottom of these buckets are held shut by the upper bail, which is used in lowering the load. When the bucket strikes bottom the hook attached to this bail drops loose, and the bucket is picked up by a chain at the end of the hoisting line attached to the lower bail. The buckets have vertical wood strips bolted to them outside to prevent catching on the concrete shells.

DIVING BELL PREPARES FOUNDATIONS

It has been brought out that the work of preparing the foundations for the shells is another important factor in the speed of the job. The diving bell now being used is illustrated in the accompanying drawing. As there is a 6-ft. tide, it carries from 20 to 25 lb. of air when in use. To float it the working chamber is covered, except for the cylindrical well in which the shafts are located, by a wood ballast tank. This is emptied by forcing the water out with compressed air, and by pumping. As originally planned the ballast tank was to be emptied by pumping, and the pump was supplied with only one suction. This made it impossible to empty the tank when the bell listed in the opposite direction from the side on which this suction was located. When air was applied an outlet was provided in each corner and each one was controlled with a valve so that the pipe at the highest point could be closed, forcing the water from the lowest point. The ballast tank for the new bell, if made, will be of steel plate, so that high-pressure air can be used to empty it. This is not possible with the present bell, as the high pressure causes the timbers of the ballast tank to give, and loosens the calking.

When the bell is in use the central well is also pumped full, sometimes above water level to help hold it down. As the bottom is rock, and the cutting edge of the bell can easily be mudded up, little air is needed. It is thought that the 400-ft. compressor now installed would easily take care of a larger bell. The main problem with the new one, which would cover six foundation stools or pedestals at one setting, would be to dispose of muck in cleaning up the bottom after the pedestals were concreted. It is thought that this could be solved by locking the muck out through the sides of the bell at several points in horizontal pipe locks.

For several points where the rock lies



DIVING BELL AND TENDER AT WORK, AND ONE OF THE FOUNDATION PEDESTALS FOR THE INITIAL SUPPORT OF THE STACKS OF SHELLS too deep to build on directly, but not deep enough to require a rubble mound, mass concrete will be used up to 45 ft. below low water. This will be placed in an unusual way, as it is not expected that the diving bell will have to be used to go over the work and level it. It is for this work that the floating mixing plant will be used.

A cofferdam 120 ft. long of 64-ft. steel sheeting is set around a section including the foundations for five stacks. Concrete is then deposited under water to bring the bottom within 6 or 8 in. of the grade of the bottom shell. When this has set sufficiently to resist displacement, the laitance and slime will be cleaned off the rough surface and concrete pedestals will be placed at the front and back ends of each line between adjoining stacks of shells and leveled under water. Upon these pedestals the shells will be set in the usual way. After the stacks are set, the space beneath them over the mass concrete will be filled by the concrete deposited in the pockets. The steel piles will be withdrawn, of course, as soon as the foundations have been prepared.

OPERATION OF DRILL BOATS

The submarine blasting is being handled by two drill boats, one equipped with ten and the other with seven drills. Besides the boilers and engine for running the battery of churn drills, each boat has four spud engines, and also two double-headed steam winches. From each of the latter a wire rope is run out in each direction, either ashore or to anchors. This gives a pair of lines on each side. Also, one line on each end is provided, making six lines in all. Each of the six lines runs through a heavy cast-iron grip or clamp, bolted to the deck of the barge and operated with a lever. When the barge is to be moved back, the spuds are pulled, the lines put on the winch heads, the clamps loosened, and one pair of lines paid out while the other is taken in. The clamps can be set instantly and save tying the lines off each time to hold the boat.

BIG DIPPER DREDGE AND 310-TON SELF-HANDLING ORANGE-PEEL DREDGE TAKE CARE OF BULK OF SUBMARINE EXCAVATION AT HALIFAX OCEAN TERMINALS

The holes drilled by these boats average about 16 ft. deep and are loaded with 75 and 80-per cent gelatin dynamite. They are spaced 7 ft. apart along the line of the drills, and rows are drilled 10 ft. apart. Each boat can drill, load and fire one and one-half rounds per shift. The method of loading the shots, and of using the spuds to raise the boat and pull the casings, was described on page 395 of the Engineering Record of Sept. 25, 1915. The clamps used for the latter purpose are shown in an accompanying illustration.

Two dipper dredges, one clamshell and one orange-peel dredge have been used on the work. At present the larger dipper dredge and the 310-ton orange-peel are handling the submarine excavation, while the 5-yd. clamshell is used for miscellaneous work. The smaller dipper dredge was employed in digging a channel to the stone quarry, and has since been sent elsewhere.

The big orange-peel dredge is a remarkable tool because of its wide digging range. An area on either side of the hull 20 ft. across and more than 160 ft. long can be cleaned up at one setting of the scow. This tool, which can handle 100 tons at maximum radius, is also held in reserve for placing the concrete shells. It was assembled on shore and run upon the barge under its own power, and it would not require much time to run it back upon the completed wall for setting blocks. While this dredge cannot, of course, handle nearly the same quantity of material as is dug by the 12½-yd. dipper dredge, it is very economical of coal and can be run by a crew of seven men. It also has a set of engines for handling its 3-ft. square spuds. These are supplied by a steam line connected to the crane boiler by a hose. The dredge is moved in the same way as the drill scows.

The job has, of course, a completely equipped machine shop. One of the lathes in this shop is of unusual size for a construction job, because of the heavy machine parts that have to be worked. The shop is located in an old brick building, once a distillery, on Pleasant Street, opposite pier A. In the second floor of this building are the store rooms, and on its upper floor are sleeping rooms and a mess hall that accommodate 100 men, about a fifth of the force employed.

PROGRESS IN PAST SEASON

The first shell was set Sept. 25, 1915. Up to Dec. 22, 1915, thirty-eight stacks of shells had been set and concreted along the north side of basin 1, this section, 850 ft. long, being now ready for backfilling.

The Halifax Ocean Terminals are being constructed for the Dominion Government under the Department of Railways and Canals, of which the Hon. Frank Cochrane is minister. F. P. Gutelius, as general manager of the government railways, is in general charge of the project, while F. W. Cowie, chief engineer of the Montreal Harbor Commission, is consulting engineer for the dock construction. James McGregor is superintending engineer at Halifax of the entire project, while A. C. Brown is the resident engineer on the dock work. The general construction methods, the diving bell and the apparatus for lifting the concrete blocks were devised by the government engineers. Foley Bros., Welch, Stewart & Fauquier, contractors for the harbor work, have originated much of the construction plant and details. They are represented on the ground by J. P. Porter, a member of the firm. L. G. Fuller is superintendent and J. W. Roland chief engineer for the contractors.

Accurate Relief Map Embraces 10,000 Square Miles

Entire Los Angeles Aqueduct Drainage Basin Is Shown on Model Based on Government Topographical Sheets

IN ORDER to present an accurate bird's-eye view of the entire area drained by the Owens River and traversed by the Los Angeles aqueduct, there has been built up by the Los Angeles Bureau of Waterworks and Supply a relief map that shows the contour of every slope in an area of 10,000 sq. miles, or about one-fifteenth of the entire area of California. Before starting the construction of the map negotiations with the United States Coast and Geodetic Survey induced that department to cover in the usual way some unsurveyed parts of the area involved, so that the regulation topographical sheets were available for all the territory to be represented.

The map is built on a horizontal scale of 1 in. to the mile, which made it possible to include the entire area in a map 27 ft. long and 32 in. wide. The vertical scale is 1/16 in. to 100 ft. It is notable that the map includes Mt. Whitney, the highest point in the United States (el. 14,502 ft.), and ten other peaks more than 14,000 ft. in elevation, as well as a considerable area of desert land which is only slightly above sea level, and in fact includes a part of the county in which is located the point of lowest elevation in the United States.

HOW THE MAP WAS MADE

The map was built in several sections, each supported on a plane wood surface whose level was adopted as the lowest elevation shown on the topographical sheets for this section, and was used as a datum plane from which to build up the higher elevations. Sheets of red fiber 1/16 and 1/32 in. in thickness were used for building up the superstructure of the map, the 1/16-in. or 100-ft. sheets being used where the contours were close together and the 1/32-in. sheets for plain areas or wherever the 50-ft. contours showed the slopes to better advantage. Pantagraphs were used for transferring the contour lines from the topographical sheets to the red fiber. The fiber sheets were then sawed out in exact conformity with these lines, and after being carefully orientated on the map, each successive layer was fastened in place by brads. A sufficient number of brads was used to obviate the possibility of warping or buckling in the successive layers. Approximately 1000 lb. of the fiber was used in the construction of the map, about 25 per cent of this being necessarily wasted in cutting the irregular contours or discarding pieces too small for use.

When the apices of mountain peaks were being neared, where the area of the fiber sheet became so small as to interfere with accuracy, a plaster compound was substituted; this was moulded into place by hand and the contour of its surface checked up by dividers. By way of final finish an artist was employed to paint the map in colors conforming to the natural landscape of snow fields, forested slopes or yellow desert wastes. The aqueduct itself is shown by a heavy line, and the names of railroads, towns, etc., are delineated for identification.

FIVE MONTHS REQUIRED IN MAKING

The construction of the map required the entire time of four or five men from the drafting room and engineering staff for a period of about five months. Their instructions were to see that the model was as accurate as it was practicable to make it. One of the features of the finished work is that geological "faults" are brought out in a more striking manner than would be possible with any other method of representation. The map makes it possible to study the geological formation of the entire area in a general way and, on the whole, to get a very definite idea of just what relation each part of the water supply system bears to its neighbors.

As shown at the International Engineering Congress the map was supplemented by a background of forty transparencies depicting scenes along the aqueduct during and after construction. These views were 18 x 22 in. in size, arranged so as to be opposite the corresponding positions on the relief map. The transparencies were surmounted by a panorama 24 ft. long showing the higher part of the Sierra Nevada mountain range which the aqueduct traverses.

The map was constructed by the Water Department drafting-room force under the direction of William Mulholland, chief engineer, who conceived the idea of representing the drainage area on an accurate and adequate scale.

A MEMORIAL TO MAJOR JOHN WESLEY POWELL, the scientist who first explored the Grand Canyon, in Arizona, has been completed on the rim of the canyon, states a bulletin from the U. S. Department of the Interior. The memorial is an altar decorated in Indian imagery and supporting a bronze tablet, resting upon a pyramidal base of rough-hewn stone. Fifteen steps lead from the west up to the altar floor, from which one may gaze into the very heart of the glowing mile-deep canyon. The structure is considered worthy alike of the rugged, forceful personality of the man and of the titanic chasm which it overlooks.

BUILDING A CANAL ACROSS THE DESERT—THIS DRAGLINE DRAWS POWER FROM A STATION 75 MILES DISTANT

Electrically Driven Dragline Scrapers Dig 45-Mile Irrigation Canal

Unit Costs Given of Excavating 1,500,000 Cu. Yd. in Two Seasons with Two Machines on Sun River Reclamation Service Project

ELECTRICALLY-driven dragline scrapers have excavated economically a long canal at the Sun River project of the U. S. Reclamation Service, from 8 to 20 miles from the nearest railroad from which fuel for steam-driven units could have been obtained. The low unit costs, methods of handling the machines on sidehill work and continuity of electrical service make the records obtained of value to the engineer who has an excavation problem involving any fuel difficulties.

LOCATION AND CONSTRUCTION PLANS

The project is situated immediately west of the junction of the Sun River with the Missouri at Great Falls, Mont. The construction of the first unit of the north side development of the project involves the building of a 45-mile canal in heavy material. On account of the high cost of fuel for construction machinery it was determined by the engineers of the Reclamation Service to supplant coal with electricity from the nearby hydroelectric developments on the upper Missouri.

Early in the spring of 1913 arrangements were made with the Great Falls Power Company for the delivery of power from its plant at Rainbow Falls to three points on the canal line, from which it could be distributed along the work as required by the type of equipment used. The power company's transmission line from Rainbow Falls to the diversion dam at the upper end of the canal line is 75 miles long, and while its construction is simple and inexpensive, the engineers state that it has proved efficient for the service required of it. Power is transmitted at 48,600 volts over wires strung on 45-ft. cedar poles with a span length of about 350 ft. Each conductor is three-strand copper wire, carried by suspension insulators on wood cross arms. A fourth stranded steel cable is grounded at each pole to help keep the line clear of static disturbances.

MAKING A SIDE-HILL CUT

At canal miles 1, 20 and 36 power is delivered to substations of 700 to 1600 kva. capacity, where the voltage is reduced from 48,600 to 16,500 for distribution along the canal. The distribution line is on 30-ft. fir or cedar poles with span lengths of 150 ft. The circuit is three copper wires with pin-type insulators on single wood cross arms, and no ground wire is used.

MOTOR-DRIVEN DRAGLINES

A contract for the excavation of the canals, stipulating that electrical energy should be used wherever power was required, was let to MacArthur Brothers Company, of New York. The contractor decided to use dragline excavators for the major part of the work, subletting to team outfits such sections of the canal as could not be economically worked with dragline machines. The larger of the machines, a Bucyrus class 24, is equipped with a 100-ft. boom and a 3½-yd. extra heavy Page bucket. The motors are of the slip-ring induction type, designed for heavy intermittent reversing service, and are wound for 440 volts. The main motor is 200 hp. and the swinging motor 115 hp. The machine is operated through a remote-control, solenoid-operated Cutler-Hammer switchboard, set at the rear of the deck house and so arranged that it is impossible for the operator to overload the motors by improper handling of the levers. Brakes and frictions are air-controlled from a compressor run by a 2½-hp. motor in the rear of the house. The machinery is mounted on a heavily braced structural-steel frame, set on skids. The dragline is moved on rollers and timbers. The smaller machine is a class 20, similar in design to the larger one, but equipped with an 85-ft. boom and a 2½-yd. Bucyrus bucket.

Teams Haul Transformers

For transforming the 16,500-volt line current down to the voltage required by the motors, two sets of transformers are required. One set, stepping from 16,500 to 2200 volts, is mounted on heavy trucks and hauled along by teams as the work proceeds. Connection is made to the 16,500-volt line at some convenient point and current transmitted at 2200 volts through a triple-conductor, steel-armored cable to the second set of transformers. These are mounted under the floor on the frame of the machine, and step the current down to the 440 volts required by the motors. The steel cable is about 1000 ft. long and obviates the necessity of moving the high-tension connection when the line is alive, as the machine can move along 1500 ft. or more without moving the transformers.

The machines were hauled to the site of the work knocked down, and were erected in the field. Excavation was started in March, 1914, and has continued steadily ever since, with the exception of minor breakdowns and the shutting down of the class 20 machine for three months during the winter of 1914-15. At the time the work was started the construction of irrigation canals in heavy material by electrically driven draglines was more or less of an experiment, but the results have been far better than were expected. The power supply has had few interruptions, and only one of more than four hours' duration. This was caused by a heavy sleet storm breaking the wires on the 48,600-volt line.

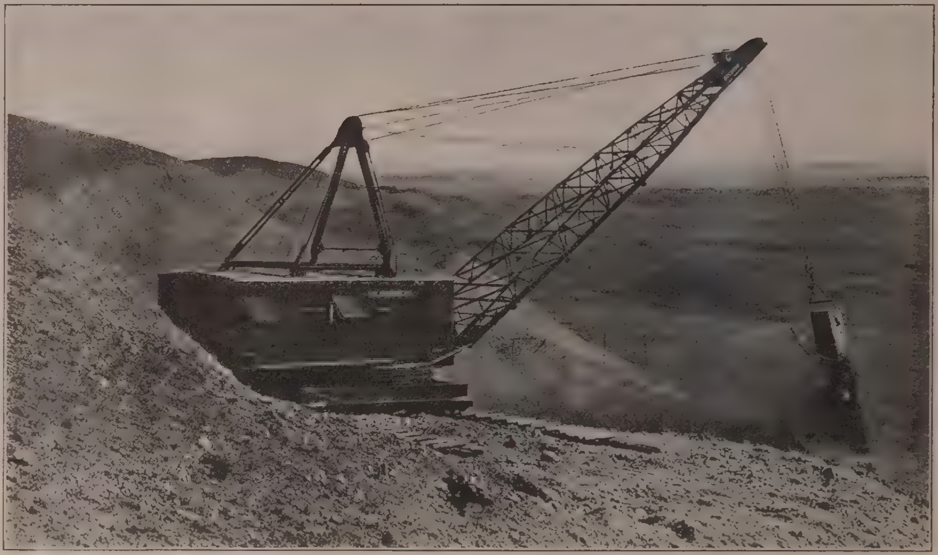
Roads for Sidehill Work

It was expected that the handling of the machines on sidehill slopes as steep as 2½:1 would be slow and probably dangerous. Whenever sidehills were encountered the machines were used to excavate and level ahead of themselves a road from 30 to 35 ft. wide, on which the timber track was laid. This advance grading was at such elevation as would produce the most efficient work of the bucket and still keep the track excavation within the lines of the completed canal, thereby rendering unnecessary any non-productive excavation by the machines. At several points on the canal the upper cuts were as great as 90 ft. By excavating the grade of the track 50 ft. above canal grade, however, the upper part of the slope was excavated without double handling of the material. The engineers state that the machines far exceeded the expectations of the contractors in their ability to dig down on a 1½:1 slope and load the bucket to capacity.

Handle Sandstone Without Explosives

The material excavated varied from a gravelly loam to cemented gravel, glacial drift and sandstone, and the topography from a level prairie to a steep, rocky hillside with transverse slopes of 2½:1. In the heaviest material blasting was resorted to, but in several instances the machines have dug 8 or 10 ft. of seamy sandstone without the use of explosives. About 1,500,000 cu. yd. of excavation has been handled by these two machines in two seasons, and costs are given here for some of the work, showing the nature of the material handled and the working conditions.

Power consumption has varied from 0.8 to 3.0 kw.-hr. per cubic yard of material moved, depending on the nature of the material. No attempt was made to obtain record-breaking outputs for the machines, as it was realized that with frequent moves, rough topography and the condition imposed of placing the material so as to produce a watertight bank, outputs would not be comparable with those of machines working in a large pit and wasting the material or loading it into cars. Outputs of 1450 cu. yd. per eight-hour shift and 32,000 cu. yd. per shift per month have, however, been obtained under the above conditions. The crew required to operate a machine for one shift has been one operator at from $175 to $200 a month, one oiler at $2.50 a day, four trackmen at from $2 to $2.50 a day and one team to move track timbers, etc. Electrical work for all shifts has been performed by an electrician or electrical foreman who received from $150 to $175 a month.



MACHINE DIGS A WORKING BENCH WITHIN THE CANAL PRISM

Costs Analyzed

Interest on investment includes all charges for insurance, bond premium and interest on cash capital required. Preparatory expense includes all charges for the delivery and installation of plant and accessories. Plant depreciation includes all charges for repairs and depreciation of tools and machinery. Under the classification adopted for excavation class 1 includes all material that can be plowed to a depth of 6 in. with six animals of 1400 lb. or over, and boulders of less than 2 cu. ft.; class 2 includes indurated material that cannot be plowed to a depth of 6 in. with six animals, but after being loosened can be excavated by teams and scrapers, and also boulders from 2 to 10 cu. ft. in size; class 3 is rock in place not included in classes 1 and 2.

TABLE 1—EXCAVATION COSTS IN CENTS PER YARD WITH CLASS 24 ELECTRIC DRAGLINE VALUED AT $36,326.63

Item	Class 1, 333,689 cu. yd.	Class 2, 23,319 cu. yd.	Class 3, 39,045 cu. yd.
Interest on investment....	0.81	1.21	2.25
Preparatory expense	1.33	1.99	3.73
Plant depreciation	3.63	5.41	10.12
Executive	0.89	1.24	3.09
Labor	5.98	7.85	21.03
Electric power	0.73	1.03	1.82
Supplies	1.13	1.67	6.72
Miscellaneous	0.16	0.15	0.29
Total	14.66	20.55	49.05

TABLE 2—EXCAVATION COSTS IN CENTS PER YARD WITH CLASS 20 ELECTRIC DRAGLINE VALUED AT $20,957.13

Item	Class 1, 410,747 cu. yd.	Class 2, 4,180 cu. yd.	Class 3, 9,546 cu. yd.
Interest on investment....	0.44	0.76	1.61
Preparatory expense	1.12	1.20	2.52
Plant depreciation	1.86	3.22	6.79
Executive	0.71	1.31	3.14
Labor	3.70	8.22	15.77
Electric power	0.78	1.78	2.80
Supplies	1.29	1.53	7.50
Total	9.90	18.02	40.13

Costs for the class 24 dragline are for the construction of 2 miles of canal on heavy sidehill and ½ mile of canal entirely in cut. The sections excavated were from 12 to 22 ft. in bottom width with side slopes of 1:1 and 1½:1. Costs include the hand trimming of 9000 ft. of the canal for placing concrete lining.

Costs for the class 20 dragline are for 5 miles of canal with 22-ft. bottom, and 4 miles of canal with 27-ft. bottom. Side slopes in both cases are 1½:1. The topography was rough, rolling foothill country, with the surface covered with large boulders. About 25 per cent of the canal was wet in the bottom from springs.

The work has been done by Buchanan & Company and Yale & Reagan, subcontractors under MacArthur Brothers Company. William Buchanan, Jr., is superintendent for Buchanan & Company, and A. W. Riney superintendent for Yale & Reagan. The general contractors are represented by Roderick McClure, superintendent. The work was under the immediate supervision of C. L. Bailey, A. F. Ross and V. W. Russell, resident engineers for the U. S. Reclamation Service. A. H. Ayers was construction engineer on about 75 per cent of the work, under R. M. Snell and Charles P. Williams, project managers for the Service.

SEWAGE TREATMENT IN SMALL COMMUNITIES when a sewerage system is not available, is described in detail by Paul Hansen in the *Illinois Health News*, the bulletin of the State Board of Health. Miniature Imhoff and septic tanks, subsurface irrigation systems and the methods of their maintenance are noted.

Greenheart, Used in Panama Canal, Is a Timber with Exceptional Qualities

Part I—Timber Imported from Demerara, British Guiana, Is Practically Unknown in This Country—Strength Is Great but Cost Is High

By A. K. ARMSTRONG
Engineer in Forest Products, Forest Products Laboratory, Madison, Wisconsin

IT IS an odd circumstance that greenheart (*Nectandra rodioei Schomb*) is a timber almost unknown to the engineers of the United States. Before its recent use in the construction of the lock gates and drydocks of the Panama Canal it was practically unknown in this country, even by name, although it has been in extensive use abroad for more than a hundred years. Its undoubted value to the engineering profession is exemplified by its numerous good qualities. Its strength as a post or beam and its stiffness are considerably higher than that of the strongest and stiffest of the 130 North American woods so far tested at the Forest Products Laboratory. It contains heartwood that is almost immune to decay, and which is probably more resistant to the teredo and other marine wood-borers than any of the hundreds of species of timber so far used as piling. In Europe it is generally considered of more value for lock-gate construction and piling than iron, or timber of other species, and finds extensive use in many places where a material of great durability and resistance to the marine wood-borers, coupled with other highly desirable physical and mechanical properties, is desired.

It is the purpose of this article, published in two parts, to aid in introducing this timber to the engineer through a full review of its properties and uses, and such other information upon it as the writer has been able to collect from numerous sources.

GREENHEART LOGGED ONLY IN DEMERARA

While growing in other portions of South America and in the West Indies, greenheart is now logged only in Demerara, British Guiana. There it is most plentiful, reaching its best development on a strip between 2 and 3 miles wide, just back of the deposit of alluvial soil along the coast and rivers. The workable area from which it is cut is about 14 per cent of the entire forested area of Demerara, and is confined to the more accessible parts of the country, extending from the sea coast to the rapids and falls of the larger rivers. In some parts of this area the stand has been materially reduced through overcutting; but the present government restriction, allowing no trees to be cut that squares less than 10 in., tends to provide for future crops in the old cutting areas.

Greenheart, in Demerara, is not under private ownership; the British government holds the entire stand. Private individuals, or companies, lease parts of the area, but they can sell standing timber only by permission from the Crown.

The tree attains a height of from 60 to 100 ft., the diameter ranging from 2 to 4 or more feet. The bole is generally clean and symmetrical for the first 50 or 60 ft. The tree, however, grows very slowly and one of the merchantable size (say 20-in. diameter) is about 250 years old.

SIZES AND FORMS OBTAINED IN WOODS

Since 1840 the average dimensions of export timbers seem to have remained fairly constant—from 12 to 18 in. square, and 25 to 50 ft. long. Timbers can be had up to 24 in. square and 70 ft. long. The timber is generally hewed, and is often shipped from Demerara with a great deal of wane left on the edges near the smaller end. No allowance is made for wane in calculating the cubic contents of the logs.

Since the logs have to be hauled by hand over corduroy roads to the nearest stream, the operation is facilitated by hewing the logs, and by "sledging," "snaping," or "sniping" their butts—that is, a bevel is cut, beginning from 2 to 5 ft. from the butt. Very often this end is not squared off before shipment abroad. The timber, however, does not taper as much as European oak, which adds to its favor among European contractors.

Carey sums up what seems to be the opinion of British engineers, that greenheart arriving in England is usually so misshapen and irregular in size that, as a material for piles, it cuts to great waste, thus increasing its cost.

CARE NECESSARY IN SEASONING

Care is necessary in seasoning the timber, owing to its tendency to check and split at the ends. The logs, however, do not check and split any more in seasoning than many other hardwoods in common use.

While awaiting shipment in Demerara, the timber is stored along the banks of tidal rivers, where it is submerged at every flood tide. The majority of the logs lie on these flats one year before shipment or sawing. This treatment is given the timber in order to prevent the forest borers from injuring it. It seems to be good practice to specify that the logs shall be felled and hewed at least one year before shipment. This is supposed to insure a proper preparation for use, provided the logs, after hewing, are stored as described. This seems to be a method developed through experience, since, although foreign users never specify that the timber shall be seasoned at all, it is probable that the timber they receive has gone through the treatment described, with entirely satisfactory results.

DIFFICULT TO SAW GREENHEART

Some greenheart is sawed before shipment from Demerara. Baterden states that the wood of greenheart possesses a poisonous character, rendering care necessary in working it, since splinters getting into the hands are known to have caused death. This property is not mentioned by any other writer and it is possible that Baterden had some other Demerara wood in mind. At least one other species from that region is reputed to yield a poisonous wood.

Greenheart is, however, a difficult timber to saw, owing to its tendency to splinter. Unless special saws are used in the mill, it may split from end to end in passing through them and when being converted into 2-in. plank may break short across the grain. These evils are prevented by cramping behind the saw. In cross-cutting, the timber should be hooped with iron on either side of the proposed saw-kerf. It is always necessary to support it under the kerf of the saw. If these precautions are not observed, flying splinters may seriously injure the men handling it. These remarks apply primarily to circular saws.

OVERCOMING DIFFICULTIES IN SAWING

These difficulties have in recent years been overcome by the introduction into Demerara of self-contained vertical saw frames, with a 24 to 30-in. stroke and a roller feed. No other type is now used. Even with these special saws the conversion of greenheart is a difficult and slow operation, so that the exporters prefer to ship hewed timber.

In sawing, it is estimated that only 1 cu. ft. of material can be obtained from 3 cu. ft. of hewed timber, if it is calculated that slabs, ends and occasional hollow logs cannot be sold locally. In Guiana, however, the refuse has a high market value, so that sawed timber, instead of selling for three times as much as the hewed, averages only from 70 to 115 per cent higher in price. In many cases the purchase of sawed timber is worth while, since sawing removes the larger part of the sapwood and exposes defects.

QUALITY OF TIMBER EXPORTED

The best quality timber is secured from trees more than 2 ft. in diameter. The timber is generally straight-grained and sound, and remarkably free from knots. The freedom from knots is due to its naturally clean bole, and to the fact that the part above the first branches is seldom logged. The soundness of the export timber may be attributed in part to the method of paying the woodsmen, who receive so much per tree for felling sound trees only, and are, therefore, careful to avoid any that show the least suspicion of decay. Although the logs often check into four segments, the latter usually do not continue separate for more than 2 or 3 ft. from the end. The split ends are generally cut off before shipment.

The sapwood of the logs is often attacked by a forest insect (presumably after felling), but the latter dies after the log is submerged, placed on shipboard or landed in a colder climate. Since worm holes are indications of defective wood, timber thus attacked, especially that which is to be exposed to fungi or marine borers, had best be rejected. Sometimes large and deep borings are found in the interior of a piece, no trace of which is observable from the outside. These are the burrows of tropical insects, and generally render a piece valueless.

It is a tradition in Demerara that the inherent qualities of the timber improve with its distance toward the west in that country. That from the Essequibo River is considered best. that from the Demerara intermediate, and that from the Berbice inferior. It seems that the largest trees (which contain the best quality timber) are found in the Essequibo River valley. The smallest come from the Berbice River valley, but that locality has been cut over several times. It seems to have yielded good quality timber in the early days of greenheart exploitation.

TO SECURE GOOD TIMBER

Owing to the great demand for the timber abroad, and the lack of legal restrictions upon cutting in the past, it has become increasingly difficult to secure good greenheart from the areas below the falls and rapids of the numerous streams. Beyond these obstructions, however, are valuable untouched forests, which transportation facilities might make available.

Before the timbers are loaded on the ship the checked or split ends are sawed off, and the fresh ends bound with metal hoops, in order to prevent further checking. The freshly cut surfaces are painted with red or white lead, over which 1-in. buffer pieces, covering the entire end of the log, are nailed. The removal of the split ends entails much waste, although there is a local market for the refuse.

COST IS HIGH

The price of greenheart always has been high, but it is generally lower to-day than seventy years ago. The quality does not seem to have deteriorated, although the quantity exported each year averages about 200,000 cu. ft. The price of greenheart in 1912 delivered alongside ship, British Guiana ports, was reported as approximately 32 to 34 cents per cubic foot for 12 x 12 in., short lengths; 50 to 55 cents for 20 x 20 in. under 45 ft. long, and 65 cents to $1.20 for timbers over 45 ft. long, depending on length and cross-section. The price, therefore, varies from about $27 to $100 per 1000 ft. b.m. These prices are for hewed timber, and are uniform over long periods; in the twenty-five years previous to 1908, the cost of greenheart did not materially fluctuate. Sawed timber on the average will cost from 170 to 215 per cent more.

CAUSE OF HIGH PRICE

The high price of the timber is due to a number of causes. The expenses of prospecting for new areas in a wild country are great, and the cost of surveying, rent and royalty must be borne by the operator. The trees are felled with the ax alone, since those felled with the saw are reported to be more liable to check and split. Since the wood near the ground is excessively hard and horny, the woodsmen cut to a high stump. It is, therefore, necessary to erect a scaffold at each tree, the latter being cut off 6 or 8 ft. above the ground. Great care is necessary in felling, so that the tree will not split or break, or fall where it is inaccessible for squaring and removing. This adds greatly to the cost of logging.

Transportation is difficult. Hauling to the water is done by hand. Since greenheart is heavier than water, the logs have to be slung on punts, from two to four logs per punt on the smaller streams and 1000 cu. ft. per punt on the larger watercourses. The logs also lie in storage for a year or more, thus tying up a great deal of the operator's capital.

The freight rates from Guiana in 1913 ran about as follows: To the United Kingdom by steamship, 24 to 30 cents per cubic foot, $6.72 to $8.40 per ton (of 28 cu. ft.), or $20 to $25 per 1000 ft. b.m.; to the United States via steamship, 20 cents per cubic foot, $5.60 per ton, or $16.15 per thousand; and to the West Indies, by sailing vessel, 16 to 20 cents per cubic foot, $4.50 per ton, or about $13.50 per thousand.

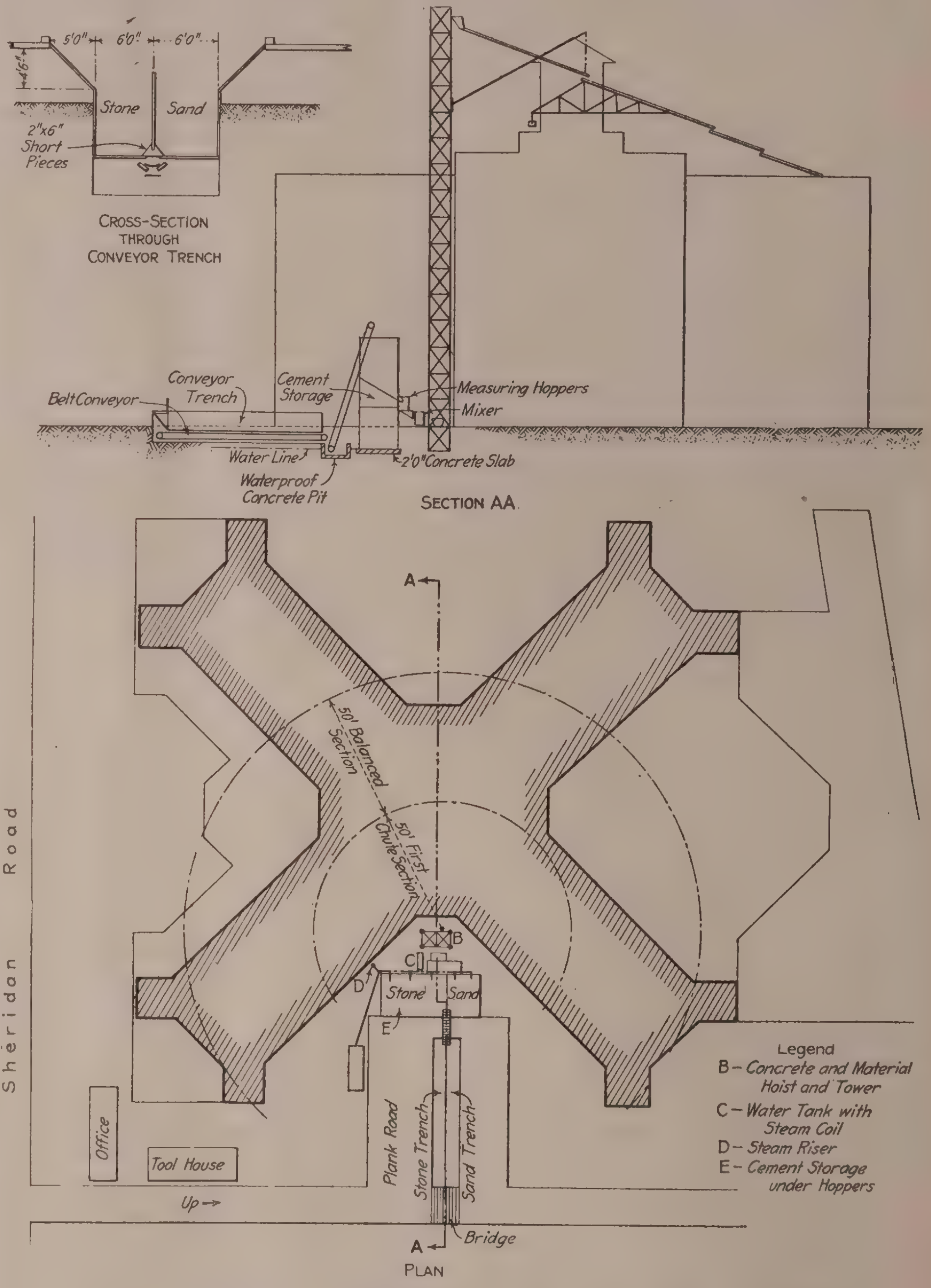
[*To be concluded in the next issue. In the second installment the author will discuss in detail the properties, examples of durability and the uses of greenheart.*—EDITOR.]

THE NET INVESTMENT of the U. S. Reclamation Service to the beginning of the present fiscal year was approximately $100,000,000.

Contractor Handles Electrically Concrete Materials for Huge Chicago Hotel

Motor Trucks Dump Aggregate Directly Into Bin Over Belt Conveyor Feeding Bucket Elevator to Material Hoppers

POURING 150 cu. yd. of concrete in floor slabs in five hours in the Edgewater Hotel, Chicago, is the usual procedure carried out by the contractor, who, in laying out his plant, had paid particular attention to the handling of the aggregates to the site by motor trucks.



PLANT LAID OUT SO AS TO BRING CONCRETE TOWER NEAR CENTER OF BUILDING

The hotel is located on the lake front east of Sheridan Road and south of Balmoral Avenue. The plan of the building is a cross with arms 47 ft. wide and 260 ft. long, the axes of which are set at 45 deg. to the line of Sheridan Road. With the exception of steel trusses over the one-story part containing the dining rooms, in the angle between the two wings facing the lake, and the steel-frame tower, the building is of reinforced concrete. It is nine stories high, and the tower in the center runs up three more stories.

Advantage has been taken of the shape of the building to erect a double hoist for concrete and material near the center of the structure in the angle between the south wings. The bulk of the floor area thus comes within a 100-ft. radius which can be handled by a swinging counterbalanced Insley spouting system with extension spouts mounted on the floor. Where wheeling is necessary beyond easy reach of the spouting, concrete buggies are used. Back of the tower is set up a 2/3-yd. mixer at ground level. Above it, as shown in the drawing, are the cement and aggregate measuring hoppers. The 2500-bag cement-storage floor under the aggregate bins is at the level of the plank road noted in the drawing on each side of the stone and sand trench. A natural sand pile at this point is taken advantage of to get the material delivered at a somewhat higher elevation than that of the ground surface near the mixer.

MOTOR TRUCKS DUMP IN UNLOADING TRENCH

As the site is covered with fine beach sand a road made of 3 x 8-in. planks laid flat was built from Sheridan Road to gain access to both sides of the stone and sand trenches as shown in the layout sketch. These trenches are 80 ft. long and each holds 400 cu. yd. of material. A single 18-in. Weller belt conveyor under the central partition is fed with sand or stone as desired by removing successively the short 2 x 6-in. pieces laid at an angle over the opening directly above the belt. The belt delivers the material into a bucket elevator which raises it 60 ft. into the storage bins, where there is capacity for 250 cu. yd. of stone and half as much sand.

At the outer end of the dumping trench is a grating bridge for the convenience of dump wagons loaded with sand. The bottom of this area under the grating is sloped to the sand side of the trench. Most of the sand, however, comes in 5-yd. motor trucks. Under the aggregate bins and cement-storage structure there has been placed a 2-ft. slab of concrete to insure the exact alignment of the various shafts and machinery bearings. This slab is just covered by the ground water and has borne its load of 2½ tons per square foot without cracking or any apparent unequal settling. Concrete, waterproofed, was also used for the pit under the lower end of the bucket elevator, which is below the water line. This sand is not quicksand; it has been found to be quite firm when wet, trenches dug in it being unwatered without difficulty.

Electricity is used to run all the equipment, energy being furnished by the Thomas Electric Hoist Company, which also supplies the 50-hp. double drum hoist for the concrete tower. As two shifts have been maintained every part of the structure is wired temporarily for lighting as fast as the floors are brought up.

SCHEDULE CALLS FOR RAPID WORK

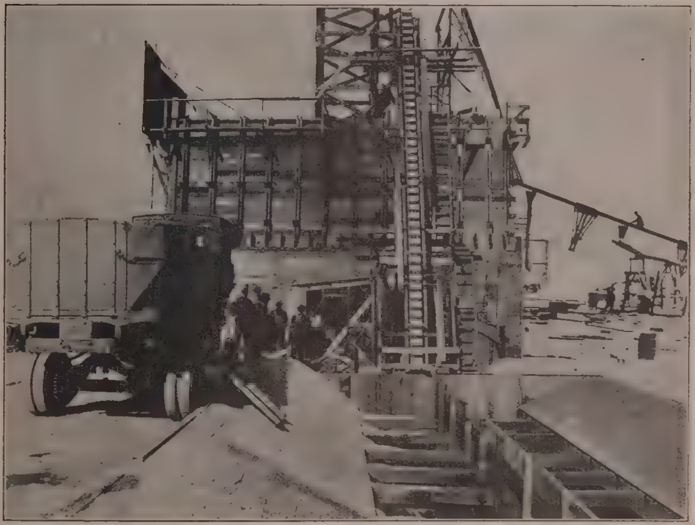
The order of concreting the floors, which has followed closely the schedule formulated in advance, required three days for placing forms, reinforcing steel, pipes and conduits. The pipes and conduits occupy one-quarter of the floor area, 6000 sq. ft. The concrete in one 7½-in. floor slab and in the columns below it is placed in five hours, an additional ten hours being required to place the cement finish. It was the idea to bring up all wings evenly, but on account of a delay in getting steelwork for the two east wings these fell behind for a time. By the tenth week, however, all of the fourth floor had been poured, bringing the wings even.

COLD WEATHER PRECAUTIONS ELABORATE

Forms for the floors are supported by 4 x 4-in. timbers spaced on 5-ft. centers. The forms are left in place two weeks, and after their removal extra form supports are placed at intervals under the floor slabs and left for some time. As cold weather came on a 75-hp. boiler was installed and steam pipes were run into the trench and aggregate hoppers. A special water tank 1½ ft. wide, 7 ft. deep and 9½ ft. long, with a steam coil through the center, was set up above the automatic supply tank to the mixer. The temperature of the water in this tank has been maintained at from 140 to 160 deg. Fahr.

To protect the poured concrete, forty salamanders fired with coke have been kept burning under the floor of each wing for several days after pouring. Tarpaulins have been hung around the sides to inclose the story below the green concrete, the temperature at no time being allowed to get below 40 deg. Fahr. Tarpaulins over the top of the floor are supported on a temporary framework about 6 ft. above the floor. A hose line supplies steam to keep this space heated for three days after the concrete is deposited. The 50,000 sq. ft. of canvas provided is sufficient to care for three wings.

Marshall & Fox are the architects for the building, and the Darling & Eitel Company is the contractor for the concrete work and part of the steel erection. Wilbur S. Sample is engineer and general superintendent for the contractor.



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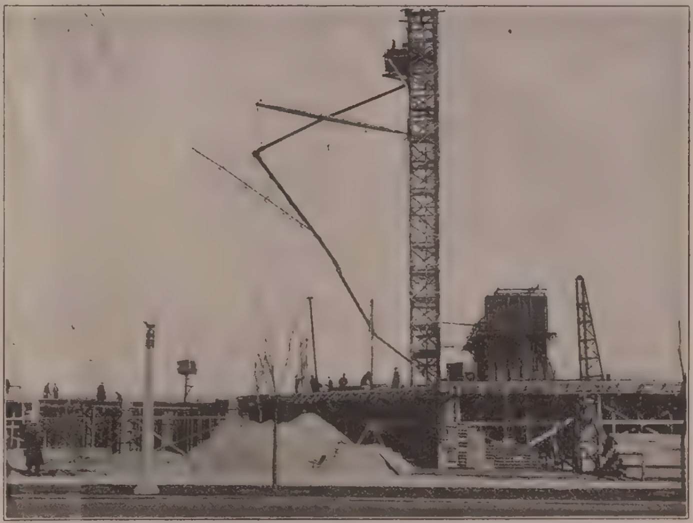
BELT CONVEYOR UNDER BINS CARRIES STONE AND SAND



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BALANCED CHUTE DELIVERS CONCRETE ON 100-FT. RADIUS

Slag Concrete Stronger than Broken Stone

Standard Cylinders of Slag Concrete Consistently 17 to 25 Per Cent Stronger in Compression than Trap-Rock Concrete

RESULTS of a series of compressive tests of standard cylinders at various ages from one month to one year show consistently higher strength for 1:2:4 concrete with slag for large aggregate than for a concrete with trap-rock aggregate graded for comparison to conform to the slag. The cement was a mixture of three standard brands—Atlas, Dragon and Kane. The sand was a typical "Cow Boy" sand from Long Island. Four specimens were tested for each case, and the averages are given in the accompanying table, including the percentage which the average strength of the slag concrete exceeded that of the ordinary trap-rock concrete.

ULTIMATE COMPRESSIVE STRENGTH OF 8 x 16-INCH STANDARD CYLINDERS

Each value, in pounds per square inch, is the average of four specimens.

	Age in months			
	1	3	6	12
National slag concrete	2465	3496	3567	4187
Palisade trap rock concrete	1975	2961	4053	3537
Percentage excess in strength	24.8	18.0	16.9	18.4

The average weight of the slag concrete was 140 lb. per cubic foot, and that of the trap-rock concrete 151 lb., while the average weight of the slag was 80 lb. and of the trap rock 100 lb. Tests of the modulus of elasticity were made on three cylinders of each kind, using average values below 650 lb. unit stress, the results were 4,126,000 for slag concrete and 4,036,000 for trap-rock concrete.

The tests were conducted at the laboratory of Columbia University and witnessed by representatives of the New York building bureaus, the Newark Building Department, the Erie Railroad, the New York Public Service Commission, First District, and the New Jersey Board of Public Utility Commissioners. The slag was furnished by the National Slag Company.

A MINIMUM HIGHWAY WIDTH OF 18 FEET will be established for future road work in Arizona, according to a recent announcement made by Lamar Cobb, state engineer. Heretofore the minimum width has been 16 ft.

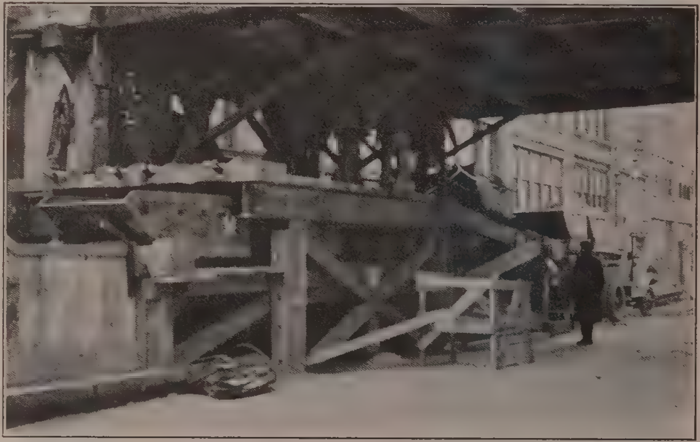
Four Street Shaft Plants to Handle 300,000 Yards of Excavation in Twelve Months

Large New York Subway Section in Crowded District Has Shafts Equipped with Double-Deck Changing Platforms Utilizing Wheeled Dirt Buckets

HOW TO TAKE 300,000 cu. yd. of rock and earth from beneath the most densely traveled parts of Broadway and Seventh Avenue, hoist it at four main shafts and dispose of it, within twelve months, was the problem confronting the Holbrook, Cabot & Rollins Corporation when the contract for the last link of the new Broadway subway in New York City was delivered to it on Sept. 8 last. The fleet of 15-ton trailer trucks carrying not two or three but six 1½-yd. skips, the dump buckets on wheels and the shaft loading platforms to change six empties for six loads in six minutes, which have been causing passers-by in the vicinity of Times Square during the past month to ask "What next?" are the answers to this problem.

EACH SHAFT HANDLES 250 YARDS A DAY

This contract, to be completed in twenty months, required three months to open up. After all the excavation is finished it will take five months more to complete and backfill the last of the subway structure. The place measurement of earth involved is 100,000 cu. yd., of rock 200,000 cu. yd. and of backfill 100,000 cu. yd. This means that even if all the material for backfill could be taken from the job itself, 200,000 cu. yd. place or 300,000 cu. yd. loose measurement of earth and rock will have to be removed from the work within twelve months if the contract is to be finished on time. There are five shafts on the work, but only four from which a continuous maximum output could be expected. Each of these, then, must handle 250 cu. yd. of material, loose measurement, every working day for the entire twelve months. No shaft plant of any of the types in use could be relied on for such an output. Such things as large dirt hoppers and a steady stream of trucks are out of the question on the crowded streets of this district, besides the fact that this type of plant does not work well with broken rock. Very large skips are slow and expensive to load underground, and to load a number of small skips on a large truck with any hoisting rig adapted to shaft work in a narrow street would cause a fatal loss of time at the shaft. Moreover, skips which would be as low as possible were necessary for more efficient loading below ground, if this yardage were to be handled. The ordinary "battleship," or double-leaf skip, stands well above a man's waist loaded on a platform car of the lowest kind, and much time is lost in loading large stones in them. A skip of this type was built with wheels, but the split bottom was not conducive to railroading. The rig could not be made rigid or strong enough to stand hard service. An ordinary dump bucket was then designed with four wheels, as shown in the accompanying drawing. It is possible to tip up this bucket, load a large stone and tip it back in less time than it takes to load stone with the hoisting line usually required below ground. A description of these buckets, built by Steubener Iron Works, and of the bail used to lift them will be found in the last pages of this issue.



→ LOADED BUCKET DESCENDING BRIDGE TO TRUCK

← LONG BRIDGE DOWN AS TRUCK IS BACKING IN

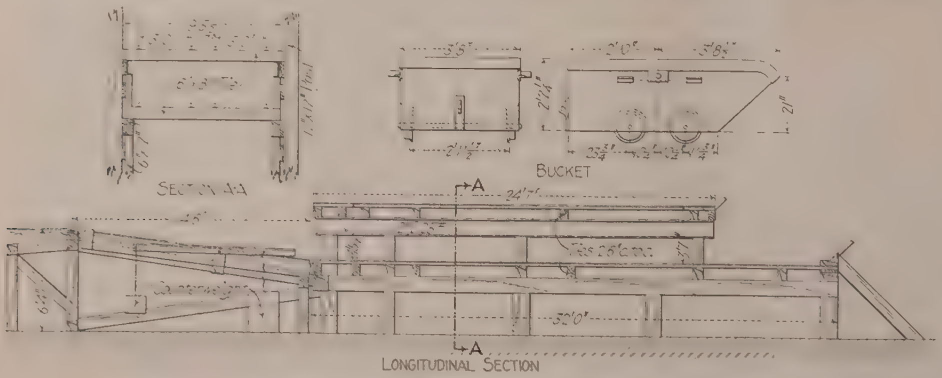
NEW SHAFT PLANT EVOLVED

Having wheeled buckets, it was possible to use this feature to cut the time of changing empty and loaded buckets on the trucks at the shaft, and also to keep the electric crane busy all the time at actual hoisting, raising a load and lowering an empty on each round trip. The loaded buckets are set on the upper tracks of the double-deck, four-track changing platform, and the empties are picked from the lower tracks. Six loaded buckets are set on the upper tracks while waiting for the next motor truck, and the six empties left by the last truck are lowered down the shaft at the same time. Connecting the two decks with the level of the truck platform is a movable bridge, lowered and raised by a small electric winch. Its outer end is hinged to a solid timber bent, and hinged timber legs on its inner end rest on the ground to support it level with the lower deck and on the latter to support the bridge in raised position. To connect this bridge and the tracks on the truck platform is a short, light bridge of four rails which is raised and lowered by a hand line. As the truck backs in, the rear end of the platform comes over a second bent which prevents deflection as the loaded buckets pass upon the truck. The truck is guided into exact line with the bridge tracks by channel-and-timber guides set in the pavement, and its rear wheels ride on a channel-iron track to prevent settlement due to tearing up of the asphalt pavement, which at first caused much trouble.

OPERATION IS RAPID

The truck is backed home and chocked, the long bridge being lowered. The short bridge then drops into angle-iron guides which line its rails up with the tracks on the trucks. The six empty buckets are then rolled off the truck to the lower deck of the platform. The bridge is then raised and the six loads rolled down on the truck. Strap-steel chocks, fastened to the two outer rails on the truck with pins similar to the familiar safety jointed shackle pin, are then set to hold the skips during their ride to the dock. The truck then pulls out and the long bridge is lowered in readiness for the next.

To check the speed of the buckets on the long bridge an ingenious brake is used. It



SHAFT PLANT CHANGES SIX LOADED SKIPS FOR SIX EMPTIES IN FEW MINUTES consists of a channel-iron and plank see-saw in the center of each track, pivoted near the center of the bridge and having a weight hung from each end. When the bridge is up the weights nearest the truck rest on the street, those nearest the changing platform also rest on the street, but with tight lines, and the ends of the plank nearest the truck stick up above the tracks. In descending the bridge each bucket has to ride over the plank and lift the counterweight next to the platform. In unloading the truck with the bridge down the brake automatically reverses itself. It is quite sufficient to check the empty buckets with the use of a light weight, but these are running onto a solid timber platform, while the loaded buckets are running onto the less secure truck. Consequently even with so heavy a weight as almost to lift the buckets from the rails a line is used to hold the loaded buckets in addition to the brake. This line has an 8-ft eye. spliced in one end, and is thrown over each bucket in turn and held by one man. The upper deck of the platform has a slight incline away from and the lower deck the same toward the shaft. Rail dogs made of round iron which slide in holes through the webs of the rails are used to hold the buckets on the upper deck when the bridge is down. The electric crane which handles the buckets in the shaft operates from a bridge over the street which has about 8 ft. clearance above the top platform. Three men are required to handle the entire work of the changing platform.

READY TO LEAVE WITH SIX LOADS

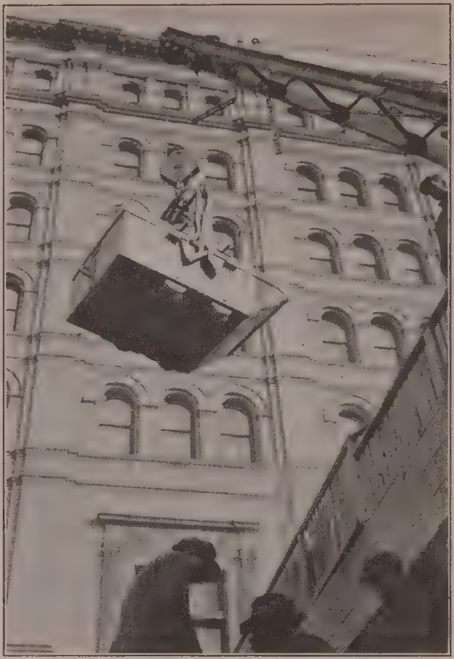
At the dock on the North River, which is more than two miles distant, two cranes unload each truck in from three to five minutes. The buckets are picked up by a latched bail, similar to that shown in the photographs, but without any braces on the back side, and are dumped directly into scows by a trip line attached to the lug at the back of each bucket. The fall of the tide, plus the difference in draft of empty and loaded scows, amounts to 12 ft. or more, making direct dumping a necessity with the heavy rock handled. The inability of the contractor to use a dumping board without risk of considerable damage to the scows was an important reason for preferring the buckets used to open-end skips.

OPERATING TIME

The round trip time of each truck will average forty minutes, fifteen minutes on the road and backing in each way, from three to five minutes at the dock and four to six minutes changing at the shaft. To change at the shaft by hoisting buckets on and off with the crane alone, which was done before the platforms were in service, averaged 25 min. per trip, and necessitated hoisting every bucket twice, once to get it out of the shaft and again to load it. With the platforms ten trips every eight hours can be made by each truck, handling 90 cu. yd., loose measurement, of muck, and each shaft can keep two trucks running, or take out 180 cu. yd. per shift.

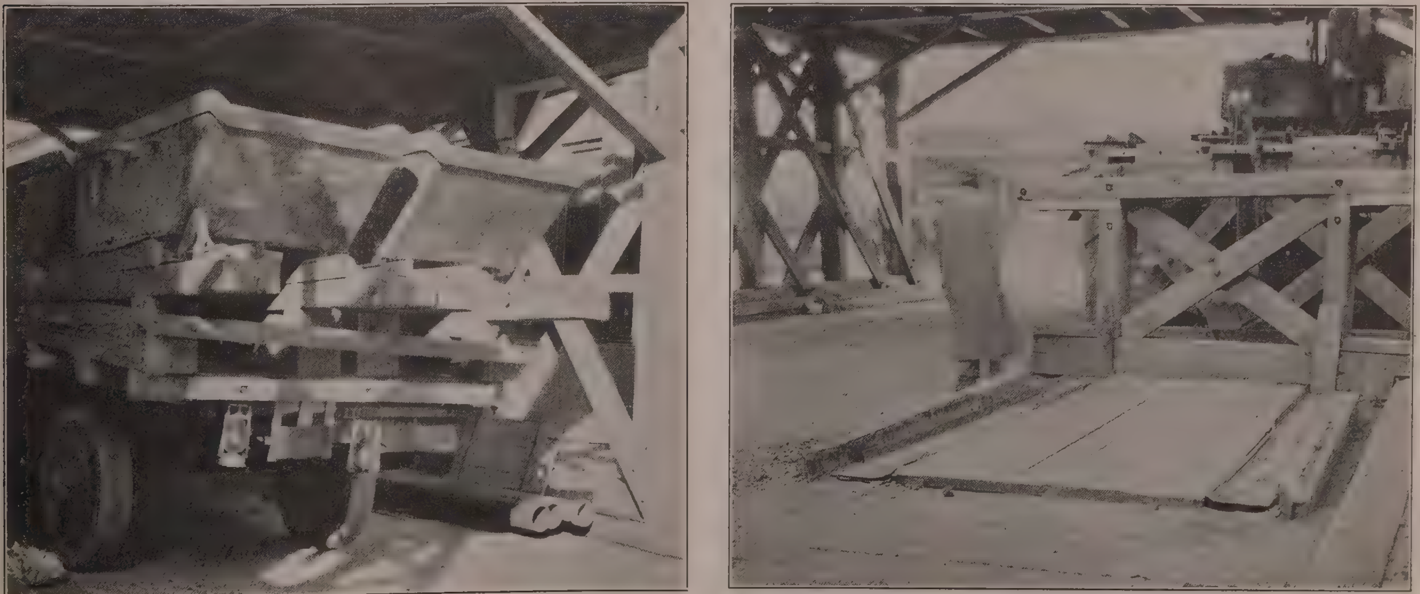
The shaft crews are little or no larger than those used with other types of plant. It is evident that the investment and shaft payroll when spread over the large yardage handled per day will show a very low rate per cubic yard.

The entire scheme, including the wheeled buckets, was originated by George Hallett Clark, who is managing the work for the Holbrook, Cabot & Rollins Corporation. The contract, which is section 3 of routes 4 and 36, is being supervised by the New York State Public Service Commission for the First District, of which Robert Ridgway is engineer of subway construction. Jesse O. Shipman is engineer of the division including the work, and Howard D. Gates is engineer on the section.



LATCHED BAIL PICKS UP SKIPS

SMALL RETARDING DAMS OF DÉBRIS AND TIMBER constructed in mountain canyons, at an average cost of $25 each, as an experiment to control mountain torrents and prevent overflow on lands below, have given exceedingly encouraging results in Los Angeles County, California. At the mouth of one of the canyons the flow was approximately ½ sec.-ft., following a 5.7-in. rainfall in 25 hours, and a previous intermittent shower of about two weeks' duration which had thoroughly saturated the ground. With approximately the same amount of precipitation before the dams were constructed the flow is reported to have been about 65 sec.-ft. The experiment was carried out by Frank H. Olmsted, member of the Los Angeles County Board of Flood Control Engineers, assisted by J. E. Rockhold, deputy county surveyor.



REAR END OF TRUCK, SHOWING DOGS AND ANGLE GUIDES FOR RAILS OF SHORT BRIDGE, AND GUIDE TRACK FOR ALIGNING TRUCK

Committee Advocates Mortar Bed for Wood Blocks

Reports in Favor of 1:4 Mixture from ½ to 1 Inch Thick at Convention of American Wood Preservers' Association

A MORTAR BED for wood-block paving, instead of a sand cushion, is recommended by Clyde H. Teesdale, H. S. Loud and Frank Cherrington in their committee report submitted at the annual meeting in Chicago, Jan. 18 to 20, of the American Wood Preservers' Association. A 1:4 mixture, brought to a thickness of from ½ to 1 in. by templates, and containing just enough water to insure a proper setting of the cement, is advocated. The intention is to produce a granular mixture which may be raked to the desired grade.

Under certain conditions, especially where vibration may be expected, the committee report specifies that a mortar cushion may be omitted and a bituminous coating of one or two thicknesses, spread upon the smoothly finished and thoroughly dry concrete base, substituted therefor. A bituminous filler for the joints is recommended.

Practices in Many Cities Summarized

In another report to the same association Mr. Cherrington gave the results of a circular letter requesting information as to wood block paving practice in a number of cities. Of 155 cities circularized replies were received from seventy-nine. The majority called for a bituminous filler, with pitch having a slight advantage over asphalt. The favored cushion is shown to be about equally divided between sand and mortar. The heavy creosote is by far the most popular preservative oil.

The data show that very few cities install the blocks by ramming the rows or courses tightly together. Most of the pavements are laid with the blocks in slight contact or by leaving interstices of at least ⅛ in. between the ends of the individual blocks. A large majority advocate laying the blocks at an angle of 90 deg. with the curb line.

Slipperiness of wood block pavement is retarded, up to 6 per cent grades, with either lug blocks, creosoted lath strips or beveled blocks. Very few cities specify expansion joints transversely; most of them require a 1-in. joint parallel and adjacent to each curb. These expansion joints are filled with asphalt, pitch, fiber or sand, the preference being in the order named. In only two instances was a cement grout filler specified for wood blocks.

THE SUDDENNESS OF FLOODS in the Southwest is set forth by J. L. Campbell, engineer maintenance of way of the El Paso & Southwestern system, in discussing a recent bridge washout at Indiole, N. M., in the August *Bulletin* of the American Railway Engineering Association. At 5 p. m. an employee passed over the bridge, a timber trestle, and at that time no rain was falling in the vicinity. At 7 p. m. a freight train plunged into the flood through the 108-ft. washed-out section of the bridge. At 9 p. m. a flagman crossed the stream on foot near the wreck. Five men were drowned in the disaster, their bodies being found from 12 to 15 miles below the bridge, and several cars, including steel coal and coke cars of 100,000-lb. capacity, were washed from 500 to 1500 ft. downstream.

Literature

For the Civil Engineer and Contractor

New Publications

Annual Report of the Director of the Bureau of Standards, 1915. Paper, 6 x 9 in., 148 pages. Washington, Government Printing Office.

Geology of the Mississippi Embayment. By T. G. Dabney. Paper, 6 x 9 in., 13 pages. Nashville, Tenn. Marshall & Bruce Company.

Bridge Foundations. By W. Burnside. Cloth, 4½ x 7 in.; 139 pages; illustrated. London, Scott, Greenwood & Son; New York, D. Van Nostrand Company. $1.50 net.

Annual Report of the Superintendent, U. S. Coast and Geodetic Survey, 1915. Cloth, 6 x 9 in.; 156 pages; illustrated. Washington, Government Printing Office.

The Ohio Water Problem. By C. E. Sherman. Bulletin 15, College of Engineering, Ohio State University. Paper, 6 x 9 in., 135 pages; illustrated. Columbus, Ohio, State University.

Petroleum and Its Products—Properties, Specifications and Tables. Bulletin 9, Kansas City Testing Laboratory. Paper, 6 x 9 in.; 19 pages. Kansas City, Mo., Testing Laboratory, 1013 Grand Avenue. 25 cents.

British Columbia Hydrographic Survey, 1914. By R. G. Swan, chief engineer. Water Reservoirs Paper No. 14, Dominion Water Power Branch. Paper, 6 x 9 in.; 534 pages; illustrated. Ottawa, Canada, Government Printing Office.

Slides at Panama. By Major General George W. Goethals, U. S. Army, Governor of the Panama Canal. Canal Record Supplement to edition of January 5. Paper, 9 x 12 in.; 17 pages; illustrated. Washington, Government Printing Office.

Engineering As a Career. A Series of Papers by Eminent Engineers. Edited by F. H. Newell, professor of civil engineering, University of Illinois, and C. E. Drayer, secretary, Cleveland Engineering Society. Cloth, 5 x 7½ in.; 214 pages. New York, D. Van Nostrand Company, $1 net.

Surface Oiling of Earth Roads. Bulletin 11 of the Illinois State Highway Department. By B. H. Piepmeier, maintenance engineer. Paper, 6 x 9 in.; 28 pages; illustrated. Copies for free distribution may be obtained from the State Highway Department, Springfield, Ill.

Problems Pertaining to Steel Tubes. By O. G. Welton, M. E., formerly lecturer and assistant professor of mechanical engineering in the School of Mining, Queens University, Canada. Cloth, 5 x 7 in.; 172 pages; 34 illustrations and diagrams. New York, D. Van Nostrand Company. $2.50 net.

Results of Observations Made at the U. S. Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Maryland, 1913 and 1914. By Daniel L. Hazard, assistant chief, Division of Terrestrial Magnetism. Paper, 9 x 11½ in.; 98 pages; illustrated. Washington, Government Printing Office.

Books Reviewed

Scientific Management and Labor

Author, Robert F. Hoxie. Cloth, 5½ x 8 in., 302 pages, New York, D. Appleton & Company, $1.50.

The author of this book is associate professor of political economy at the University of Chicago and was special investigator on scientific management for the United States Commission on Industrial Relations. The book is based upon the investigation made for that commission. The study involved chiefly shops designated by H. L. Gantt and Harrington Emerson and the late Frederick W. Taylor, so that the plants studied are representative. In this study the investigator was assisted by Robert G. Valentine, appointed by the commission to represent the employers and John P. Frey, appointed similarly to represent labor.

The greater part of the volume sets forth in some detail the findings of the author, upon which his conclusions, reported to the Industrial Relations Commission, were based. One hundred and thirty-six pages of the volume are taken up with a presentation of what was found in various shops. The remainder of the volume is given up to appendices, detailing the claims of the various efficiency systems, a statement of the vital points at issue and the exhaustive questionnaire which employers were asked to answer.

Briefly, Professor Hoxie's conclusion is that scientific management has succeeded in creating an organic whole of the several departments of a plant, establishing a coordination previously impossible. In this respect, he declares, it has conferred a great benefit on industry.

The social problem created by scientific managements, however, does not lie in this field, but in its effect upon labor. In this respect there is now no control over the introducers of scientific-management methods, so that they are free to use them for good or ill as they and the employers see fit. Thus in some shops while labor has not been seriously affected through the introduction of efficiency system, in others it has been. Professor Hoxie also concludes that neither organized nor unorganized labor finds in scientific management any adequate protection to its standard of living, any progressive means for industrial education nor "any opportunity for industrial democracy by which labor may create for itself a progressively efficient share in efficient management." There is inevitably, therefore, conflict between organized labor and those who try to use the new systems to the detriment of the worker.

The character of the material supporting these conclusions can be pretty well sensed from the conclusions themselves. Professor Hoxie found a very great diversity in the methods of scientific management, in the thoroughness of its application and in the character of results. For this variation the introducers of the system are chiefly responsible, though special conditions in the various plants have a considerable effect. He has found what one might have predicted in advance—disparity just as wide as the personalities of those installing the systems. Consequently, since both good men and poor men, good employers and bad are concerned, one can find about anything he seeks. Reading the book, one's general impression is, however, that scientific-management shops are not inferior to the run of what one could properly characterize as a "good" shop.

A German Engineering Index

Jahrbuch der Technischen Zeitschriften—Literatur. Edited by Heinrich Rieser. Paper, 6 x 9 in.; 98 pages. Vienna and Berlin, Verlag fur Fachliteratur, 4 marks ($1) net.

REVIEWED BY A. G. HILLBERG

Civil and Hydraulic Engineer, New York City.

This engineering index classifies the articles published in 257 technical journals during 1914. Most of these journals are published in the German language, but about sixty of them are of American English, French, Swiss or Italian origin.

Comparing the work with the *Engineering Index*, published by the Engineering Magazine Company, of New York, which comprises about 250 publications representing seventeen nations and six languages, of which about three-fourths of the articles classified are printed in English, it is obvious that the sale of this German index in English-speaking countries will be very limited.

The different articles are referred to by title only and thus convey little about their contents and scope. This method, however, has enabled the editor to keep down the number of pages and to give the index a convenient size.

Engineering Geology

Authors, Heinrich Ries, Ph.D., professor of economic geology at Cornell University, and Thomas L. Watson, Ph.D., professor of economic geology at the University of Virginia, and state geologist of Virginia. Cloth, 6 x 9 in.; 722 pages, 249 illustrations. Second edition, enlarged. New York, John Wiley & Sons, Inc. $4 net.

REVIEWED BY FREDERICK K. MORRIS

Department of Geology, Columbia University, New York City.

This is a textbook of intermediate character. It can be used with profit by students who have had no previous training in geology, yet the matters in it are more fully treated than in any elementary textbook known to the reviewer.

The book may be divided into three general sections: Structural and dynamic geology and related engineering problems; applied geology, under which head are considered building stones, lines and cement, coal and oil and ore deposits, and historical geology.

The treatment is largely descriptive. Features of great geologic interest such as volcanoes and earthquakes receive almost no mention. Rocks are admirably described with ample illustrations in a long chapter so clearly subdivided and systematized that students find little difficulty in mastering its contents; but the theoretic and dynamic discussions are condensed to an extreme of brevity. In discussing rivers, on the other hand, the behavior of running water as a dynamic agent receives full consideration, for the engineer who attempts river improvement must know how to utilize or oppose the energies of the stream. This is especially true in the improvement of mature rivers where great lengths of river must be improved at low cost. The essays on landslides and on lakes, are quite the best in any textbook known to the reviewer, and form a unique feature of the work.

The second division might be called applied geology. More than 200 pages are given to the consideration of building stones, limes, cement and plaster, clay and clay products, coal, petroleum and gas and other hydrocarbons, road foundations and materials, and ore deposits. The discussion of building stones is exceptionally full on the theoretic side. Not merely to describe building stones, but rather to show students how to judge them, seems to be the author's aim. Methods of testing and the relative practical importance of tests; the structural qualities which characterize good building stone, and the peculiarities of composition and structure which make faulty building stone—these and similar matters of importance to both the architect and the engineer are well treated. The purely descriptive part is adequate for the purpose, and illustrated with maps and photographs. Much the same type of comment could be made on the other chapters of this section. An intensive and qualitative knowledge is aimed for rather than such a quantitative knowledge as only a full course in economic geology can impart.

The chapter on historical geology constitutes the chief addition to the first edition. The introduction to this subject points out the importance of fossils, conditions and methods of fossilization, and the inference that may be drawn from the fossil content of rocks. The presentation gives the engineer exactly what he needs —rock types, distribution, probable altitude of beds, economic possibilities and means of recognition. He is less concerned with the physical history of the earth or the evolution of life, yet these interesting matters are not wholly neglected.

On the whole, the new edition has lost none of its good points and is decidedly more complete as a geologic textbook and more valuable also as a guide to the man in the field by reason of the additions on the historical side appearing in it.

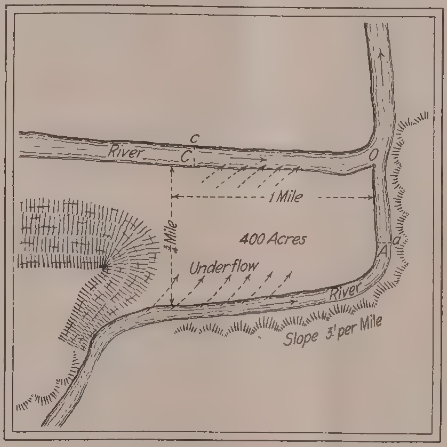
Letters to the Editor

Comment on matters of interest to engineers and contractors will be welcomed

Where Does the Water Go?

SIR:—Assume the elevation of the junction of two rivers to be 600 at the point marked *O* in the accompanying sketch. The elevation at *a*, ¼ mile from *O*, is 600.75. The elevation at *c*, ¾ mile from O, is 600.2.

With the two rivers at this stage, measurement of river A at *a* gave a discharge of 323 sec.-ft. A rise of 0.5 ft. in river C made the elevations at *c* and *a* 600.70 ft. and 600.75 ft. respectively, river A being unchanged, inasmuch as the drainage area was not in any way affected by rainfall in the drainage area of river C.



Now a measurement of the discharge at *a* gave 504 sec.-ft. The point between the two rivers consists of about 400 acres of bottomland about 20 ft. above normal river surface and underlain with a gravel bar from 10 to 15 ft. thick. My theory is that during the first measurement, because the river C was at a lower elevation of about 3 ft. than corresponding points across the bottom on river A by reason of the difference in slope of the rivers, a large part of the water flowed through the gravel underlying the land and emptied into river C above the junction, while during the second measurement, because the river C was flush, there was an elevation or head against which the assumed underflow would have been compelled to discharge. Now the coefficient of flow through the gravel might be such as to be balanced by this rise in river C, thus making the path of least resistance down the channel of river A, which would account for the larger discharge found under this condition.

River A traverses a valley approximately ½ mile wide, which is underlain with a gravel bar from 2 to 10 ft. thick from head to mouth. Measurements of the principal springs which give practically a constant discharge on the headwaters of the river aggregate 1200 sec.-ft., while at various points down the river the discharges do not increase nearly as much as the inflow from the springs, and at the mouth a discharge of from 300 to 500 sec.-ft. is all the water there is flowing in the channel above ground. While the drainage area is above that of adjacent basins an anticlinal prevents flow through the range of hills on the east side, and there are no large springs or other evidences of flow from this basin in the others.

Numerous measurements were taken and the mean computed. The method of rod floats was checked against meter measurements, and it is felt sure that the discrepancies noted are not due to errors of methods of measurement.

L. S. SCOTT.

Linn Creek, Mo.

Why Is Registration in Civil Engineering Decreasing?

SIR:—Referring to your editorial of Dec. 18, 1915, page 766, on the question of why registration in civil engineering is decreasing, and the numerous explanations which it has called forth, permit me to suggest another reason which may prove to be the principal reason why the engineering profession seems to be losing its charms for so many of our young men. I refer to the private practice of many of the engineering professors in active competition with their own alumni who have not the prestige of the university back of them nor free office rent, stationery and student labor.

Possibly the young graduate has found such competition extremely disheartening. The remedy for this growing evil is, we believe, in requiring the recipient of such professional fees to deposit them in the treasury of the university. This should discourage the practice and improve conditions in our profession.

W. J. SHERMAN,
The W. J. Sherman Company, Consulting Engineers.
Toledo, Ohio.

SIR: The writer has read with interest the discussion in the Engineering Record on the reasons for the decreasing number of engineering students in the colleges, and feels that the facts set forth should cause those who are interested in the welfare of the profession serious consideration—not perhaps so much because of the lesser number of students, as because of the reasons for this decrease. In considering the subject nothing will be gained unless it is done with an earnest desire to get at the naked truth regardless of unpleasant things we may discover about ourselves. Too often those who write on subjects related to the welfare of the engineer are prompted by selfish motives, or blinded by their own success to the actual conditions of the average man in engineering work. The conditions of the average engineer are never discussed, nor is his case presented fully.

The Engineering Record asks why, if the supply is not greater than the demand, are engineers' salaries so low? Supply and demand are not the only elements that go to fix salaries. There is fully as great an over-supply of young lawyers and doctors as there is of engineers, yet the average lawyer or doctor is able to own his own home, support his family comfortably and provide for his old age. Can this be said of the average man in engineering work? Again, is there not relatively more of a demand for engineers right out of college than for men of a few years' experience? A man with five years' experience can get nearly as good wages as a man with ten years' experience. This tends to prove that the fault is not poor training given in the schools. Is the trouble not here?

The engineers have had no organization to advance their interests. There is no helpful brotherly spirit among engineers of different stations in life. The chief or consulting engineer of fifty feels it is his duty to exploit and crush the spirit of the man of thirty in the name of his employer. This is often done by starting the young man on the work at a low salary with bright promises of a raise as soon as he has learned something of the business. What actually happens is that when he has had his experience and asks for the raise he is allowed to get another job and another cub is put through the extracting process.

This is not true of all firms, nor of all individuals, but there is enough of it to affect the salary of the average engineer and lower the general standards of the profession. There is no line to divide the engineer and the layman. Any one can set himself up as an engineer, and no one can say another is not an engineer for fear of being asked what is required to make a man an engineer. This lowers the general standard of the profession.

The Ohio Engineering Society has attempted for years to remedy this evil by having a license law passed, which would raise the standing of the profession in the eyes of the public, even if it had no other good effect. How the last bill proposed could hurt the best interests of the profession has never been explained, but the national society has stubbornly opposed all license laws. One cannot help but wonder whether this opposition is in the interest of the profession or of the employers.

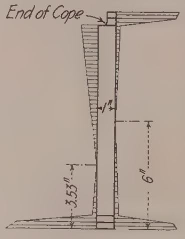
I do not believe there is an over-production of engineering graduates, but there is undoubtedly an under-consumption due to shortsighted policies of employers, which in turn is partly due to lack of general advertising and co-operation on the part of the profession, because of the lack of a strong and keen organization.

Had the national engineering societies seen their opportunity twenty years ago and started a constructive policy for advertising the profession and advancing its interests there would not be the complaint there is to-day of poor salaries; there would not be so many public bonds outstanding and maybe not so many railroads in the hands of receivers. It would seem that the stock arguments and explanations which are solemnly repeated to the average engineer every time he complains of his lot are about worn out, and that if the national societies cannot take a constructive stand of some kind in the interest of the whole profession they profess to lead they would do well to confine their discussions to strictly technical subjects. With conditions as they are what encouragement is offered to a young man to spend the four best years of his life and two or three thousand dollars on an engineering course? A few are able to make themselves comfortable homes, but there are more who are compelled to become mere floaters, kicked about the country and exploited by first one employer and then another until they take up another line of work. In closing let me remind the profession in the words of the poet—"They have rights who dare maintain them."

AN AVERAGE CIVIL ENGINEER.
Cleveland.

Shear Cracks or Tension Failure?

SIR: With regard to the shear cracks in the 12-in. 31.5-lb. stringers, reported by F. H. Avery, in the article on page 14 of your issue of Jan. 1, and noticed in one of your editorials of Jan. 8, if we neglect the 12 x 3/8-in. plates riveted to the upper flanges, and if we assume that the upper flange only is cut off in coping and none of the web, the neutral axis is found to be only 3.53 in. above the lower face of the lower flange; the maximum shearing stress estimated by the simple theory of bending is about one-fourth larger in the coped part than it would be if the beam were of normal section, while the maximum fiber stress is increased more than three times by the coping. This is in agreement with your editorial.



However, it seems to me that this is not the whole story. The accompanying sketch shows a strip, 1 in. long, cut in imagination from this beam and so located as to include the end of the cope. On the right face of this strip we have a stress distribution somewhat like that of the normal beam, while on the left face we have a stress distribution characteristic of the coped beam, or a T-beam. In this sketch I have shown, not the stress distribution, but the distribution of forces on the two faces per unit of height, all to the same scale. These forces are those due to positive bending moment and do not include shear. For negative moment the magnitudes will be the same, but the signs will be interchanged.

It will be noticed that the whole force carried by the upper flange of the uncoped beam comes as a horizontal shear on the upper part of the web, and that we have no means of estimating over how long a horizontal section this shearing force is distributed. It seems fairly evident that the shearing stress will be extremely high on a horizontal section near the end of the cope, and it seems very probable that this may start a crack with many repetitions of even comparatively small moments, either positive or negative. After the crack has once started we may expect it to become longer with repeated loadings.

These considerations confirm Mr. Avery's suggestion that coped beams should be regarded with suspicion for live loads that are often repeated.

O. H. BASQUIN,
Professor of Applied Mechanics, College of Engineering, Northwestern University.
Evanston, Ill.

To Repair the Cistern and Yet Save the Tree

SIR: In your issue of Jan. 8, page 57, Stuart T. Smith inquires how to repair a cistern without injuring a near-by poplar tree. The Carolina poplar is one of our most vigorous and adaptable species. Mr. Smith is not likely to harm the growth of this tree by cutting off such roots as may be necessary in repairing the cistern. New roots will develop very rapidly and the only bad effect will be in weakening the root support of the tree, making it liable to be thrown by the wind. If the tree has a very large top, and the roots are cut to a considerable extent on one side, the branches should be cut back severely to lessen resistance to the wind. Otherwise the tree should be braced by an iron rod bolted through the trunk and firmly anchored by chains to a "dead-man."

Incidentally the Carolina poplar is notoriously a nuisance in cities or near dwellings because of the habit of its roots to penetrate and clog drains, crack and lift cement sidewalks, etc., and also because its leaves fall throughout the summer, causing unsightly litter. Owners of Carolina poplar trees would do well to plant species like the sycamore, Norway maple, oriental plane, ginkgo or red oak, and remove the poplars as soon as the more valuable trees are large enough to require the space.

In repairing the cistern Mr. Smith would probably get best results by lining it with a cement wall 4 to 6 in. thick. The poplar roots may penetrate even a wall of this character in time, owing to the disintegrating action of the acids formed during growth. For this reason some benefit may be derived by giving the earth walls of the cistern a thick coating of coal tar before the cement wall is placed. The coal tar would have a tendency to discourage the growth of near-by roots.

S. B. DETWILER,
Philadelphia. Forest Engineer.

MARINE BORERS RIDDLED SHEATHED TIMBERS, although they did not touch similarly treated unsheathed specimens in the experiments of Dr. L. F. Shackell carried out last summer at the marine biological station of the U. S. Bureau of Fisheries, Beaufort, N. C., and reported at the recent convention of the American Wood Preservers' Association. The specimens were 3 in. square and 4 ft. long, covered by strips of 1/2-in. loblolly pine. It was explained that the borers enter the untreated sheath and grow to such size—several thousand times the dimensions of the embryonic stage—that any toxic property the preservative may have on the infant borer is lost on the full-grown individual. Dr. Shackell explained that the practical significance of the experiment lay in the absolute necessity of protecting by treatment every part of the stick which will be exposed.

HINTS FOR THE CONTRACTOR

Details Which Save Time and Labor on Construction Work

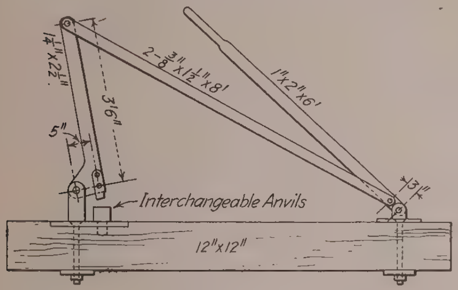
Other articles in this issue of interest to contractors and construction engineers are indexed in the Table of Contents

[*Contributions to this section are solicited, and if found available will be paid for. They must be* SHORT, *and should be accompanied, if possible, by photographs or sketches.*—EDITOR.]

Simple Rod Cutter Made in Blacksmith's Shop

By L. A. FRANCISCO
New York City

A SHEAR for cutting steel bars made for a New Jersey dredging company by one of their blacksmiths, and which is used in their repair yard, is illustrated herewith. To a 12 x 12-in. timber is bolted a 1-in. thick steel plate having two holes over the center-line of the timber. Through one of these passes the eyebolt which forms the hinge of the jaw. Into the other fit several different sizes of anvil blocks, for cutting different sizes of steel bars. The movable blade of the shear was made from an old bridge eyebar fitted with a cutting edge of hardened tool steel. The leverage shown in the sketch makes it possible to exert a pressure of about 70,000 lb. on this edge.



LEVERAGE OF ROD CUTTER GIVES 70,000 POUNDS PRESSURE

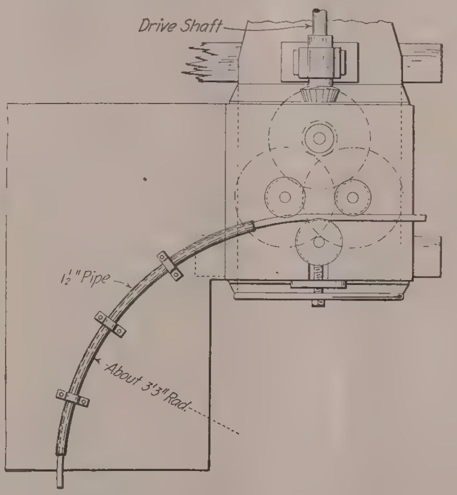
Grouting Simply Done Holds Running Sand Behind Sheeting

SHEET piling is often not absolutely tight, but lets through sand and water from behind in such quantities that it is impossible to do the required work. According to a reader, one solution of the problem thus presented is to work holes through the stiffer soil above the sand with an iron rod, withdraw the rod and replace it with a length of pipe through which grout is poured and worked down by churning. This stiffens the sand and effectually prevents it from flowing. If a long stretch of piling is troublesome it is desirable to have two lines in which the holes are staggered and about two feet apart, the first line being about three feet behind the sheet piling. This was successfully tried in building a retaining wall of reinforced concrete where the steel bars had to be anchored to the rock foundation, in connection with the construction of a surge tank, by forces of the Ontario Power Company at its plant at Niagara Falls, Ont.

After this retaining wall was built it was found necessary to strengthen it by placing more reinforced concrete behind it, which necessitated a second row of sheet piling behind the first and the excavation of the ground which had previously been grouted. This gave an admirable chance to observe what had happened in the first grouting. It was found that the grout had permeated the sand and stiffened it so that in most places it had to be broken up with hammers and picks.

Pipe "Tunnel" on Bender Keeps Curved Bars from Twisting

A LARGE number of bars bent to a three-quarter circle are required for reinforcing the shells used by Foley Bros., Welch, Stewart & Farquier, in building the pier walls at the Halifax ocean terminals. As the bars are light they would twist up in going through the rolls, and so acquire curves in several different planes. To overcome this and hold the bars flat on the table a pipe "tunnel" for the bent end of the bar to feed through was made of a piece of 1½-in. pipe. This was bent to a quarter circle and clamped down to the bending table on the circumference of a circle passing through the rolls. The bender is shown in the accompanying drawing. It was devised by C. D. McArthur, formerly chief engineer for Foley Bros., Welch, Stewart & Farquier.



PIPE "TUNNEL" PREVENTS TWISTING

Forms Wedged from Top of Shores with Superior Results

By G. W. SMITH
Engineer, Hodgin Construction Company, Omaha, Neb.

WEDGES are being placed at the top of the form shores instead of the bottom, as is the usual custom, in building the new Ford assembly plant at Omaha, Neb., for which the Hodgin Construction Company of St. Paul is contractor. When bottom wedging is used the form work must be leveled before the shores are braced, or else the bracers must be loosened for leveling. By using the system of top wedging the form work can be erected and braced and the steel reinforcing placed before any leveling is done.

On this job a flat-slab system of floor construction is being used. When a floor is ready to be leveled the level is set up at a convenient place and the target on the level rod is set for the proper grade. The column heads are leveled first by reading the rod on the four sides of the column and having two carpenters underneath to do the necessary wedging up. It is best to have the floor a little low rather than too high, as it is easier to drive the wedges up a little than to loosen them and lower the floor. After the column heads are leveled, the centers between columns are taken and given the proper crown. After this is done all the other wedges are gone over and brought to a solid bearing.

The claim for this method of wedging is that it facilitates the erection of centering. Its one disadvantage is that driving wedges while standing on a horizontal tie nailed to the shores at the proper height is a little more difficult than it would be standing on the finished floor. So far this method has been used on three floors of this building, and no cause has been found to abandon it for the usual procedure.

"Drydocking" a Tug with a Set of Chain Blocks

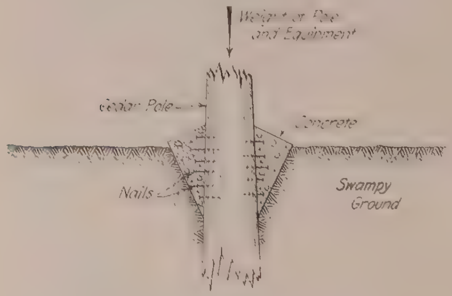
THE FACT that no great weight is lifted by tilting a floating hull to bring part of it above water for repairs has often been utilized by river contractors to make minor repairs, a derrick boat being usually employed to do the lifting. A good application of this principle, when avoided tying up a derrick boat for a day or more, is shown in the accompanying photograph. A large pair of chain blocks attached to a timber cantilevered over the edge of the lock wall was here used to raise the bow of the tug to repair holes made by running into ice, and to hold it up while the

CHAIN BLOCKS RAISE TUG FOR REPAIRS

entire bow was sheathed with metal. The tail of the timber was located over a well in the land wall which communicated with the operating culvert in the river wall, and was chained down suitably. This work was done at the Government lock and dam on the Hudson River at Troy, N. Y. The dam has just been completed by Government forces under the Corps of Engineers, U. S. Army, Col. William M. Black being in general charge of the district and Maj. M. J. McDonough having charge of the work at Troy.

Concrete Collars Economical Support for Poles in Swamp

THE BUILDERS of an Ohio transmission line which crossed swampy ground overcame troubles due to settlement of the poles by the expedient illustrated in the accompanying drawing. Poles of this sort carry loads much greater than their own weight, due to tension in the lines stretched on them and also to the pull of guy lines where it is necessary to use this means to prevent their leaning in soft ground.



CONCRETE SUPPORT EASILY PLACED

As indicated in the drawing, heavy nails were driven part way into each pole at and below the ground line. Around the pole and over these nails a circular, wedge-shaped section of concrete was molded. The nails took up the shear between the pole and the concrete, and the bearing area developed by the latter was made sufficient to prevent settlement.

Sheepskin Brush Solves Oiling Troubles in Narrow Forms

By B. M. MATHIAS

Circular Concrete Company, Minneapolis, Minn.

ANYONE who has had experience trying to apply oil to the surface of forms of the "release, raise as a unit and fill" type, extensively used in constructing concrete silos and tanks, knows that the task is not an easy one. Unless metal forms are oiled or given some kind of coating between fills the concrete adheres and a rough, unsightly surface results.

In building these thin walls (6 in. is a common thickness) the narrow space, obstructed by the horizontal reinforcing, which must be placed in at the top as the form is raised, does not permit the use of a common paint or whitewash brush for coating the mold surfaces. Oiling by spraying with a hand-pump we found objectionable, because the reinforcing steel, and also top of the previously poured wall, received too much of the shower of oil. A mop of cloth or burlap soon coats over and will not give up the oil, while on the other hand the oil readily leaks out at the bottom, making it almost as objectionable as spraying oil.

A brush that overcomes the difficulty, and one which experience on the work of this company has proved to be useful, is made by tacking a piece of unsheared sheepskin, wool side out, around the end of a thin board, of about ½ in. thickness, of convenient width and of sufficient length to reach the depth of form. The holding tacks are best put in the edge of the thin board handle. This should preferably be of hardwood to have the necessary strength and lightness. This cheap (even in these times of high-priced wool) sheep-brush makes a very efficient tool for spreading light mineral oil on metal forms. It is equally useful on wood forms if they are planed smooth and are free of splinters and so on. Of course, it is of no value when sticky oil is used.

In storing tools and machinery, a piece of sheep pelt makes a good wiper for applying a thin coating of oil to surfaces that should be protected against rust. For flexibility in getting into angles and over irregular surfaces, the wiper may be held limply in the hand, while for smooth surfaces, a brush that is easily held, and very effective in covering considerable surface quickly, is made by tacking the wiper on a block of wood.

Excavation to Backfill in One Handling via the Roof

IN the east portal of the Twin Peaks tunnel which the city of San Francisco is constructing as a municipal venture, description of which appeared in Engineering Record of Sept. 26, 1914, page 361, a considerable length of the concreting was done in open cut. It was found that the last of the excavation in this section could be expedited and that at the same time the work of backfilling on completed parts of the concrete arch could be cheapened by cutting through the arch and delivering muck direct to the backfill with one handling, using an inclined railway through the finished roof.

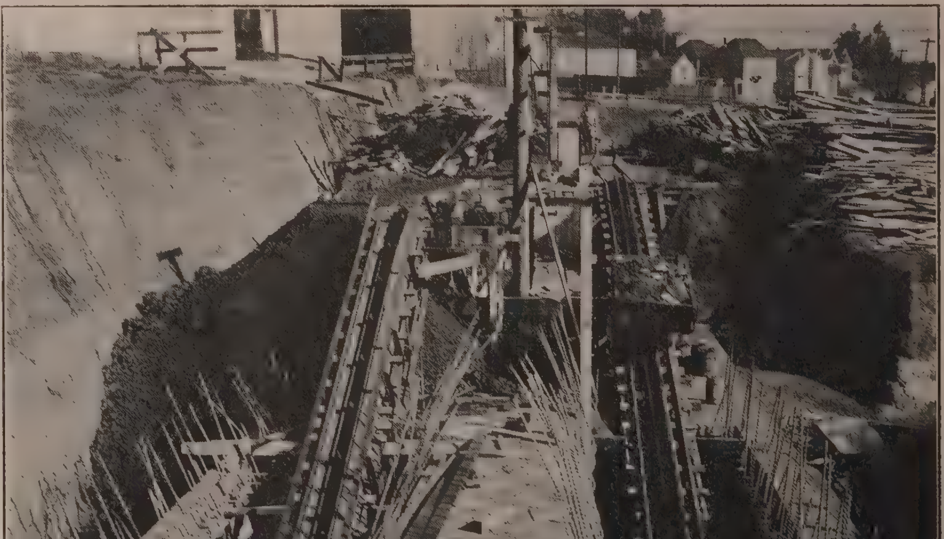
An accompanying illustration shows how this was accomplished. Loaded dump cars were delivered by gravity to the foot of the incline on the right, were drawn up by an electrically driven endless-chain belt, and after being dumped in fill were returned empty down the incline shown on the left. About 10,000 cu. yd. of material were handled over this incline improvised after the work was under way. In making the openings in the arch roof the reinforcing was left in place so that the sections could be readily restored to normal.

While mucking was in progress the electric motor ran continuously, cars being handled at about five-minute intervals. The link belt operated by this motor carried dogs which engaged steel brackets riveted to the running gear of the dump cars, so that the mechanism required no attention at either end of the incline. From the top a slight descending grade delivered the cars to the dump by gravity. On the return incline the link belt, which was not provided with power, was controlled by a hand-operated friction brake working on the shaft that carried the link belt sprocket at the head of the incline.

The most important problem that had to be solved in getting the scheme to work satisfactorily was the proper grades for the inclines. The grades first selected were too steep and a reconstruction of the track was required. As finally adopted the ascending grade was made 28 per cent and the descending grade 40 per cent. The cars handled had a capacity of 1½ cu. yd.

The work is being done under the direction of M. M. O'Shaughnessy, city engineer. The escalator was designed and built by the contractors, R. C. Storrie & Company, of San Francisco.

AN INTERSTATE BRIDGE is being constructed across the Colorado River at Topock, Ariz. The bridge will connect the highway systems of two states and is being built by joint action of California, Arizona and the federal government.



INCLINED RAILWAY DELIVERS DIRT FROM HEADING TO BACKFILL IN SAME CARS

NEWS OF THE WEEK

Passing Events in the Civil Engineering and Contracting Fields

Oscar S. Straus Strongly Approves of Engineer on Service Commissions

Chairman of New York City Board in Charge of Subway Work Tells Why Engineer Can Aid in Solving Commission Problems

Governor Whitman of New York openly professed his faith in the value of an engineer as a member of a service board when he appointed Henry W. Hodge to the Public Service Commission of the First District, which controls the New York City subway work. The public has not known, however, that the new chairman of the commission, Oscar S. Straus, is equally convinced of the need for a technical man on such a board. Mr. Straus' views are particularly important because of his business experience and his long and distinguished public service as Ambassador to Turkey and as Secretary of Commerce and Labor under President Roosevelt.

In calling on Mr. Straus to learn his opinion the representative of the Engineering Record was prepared to ask questions on the points usually argued—whether a subordinate engineering staff could not give the commission all the technical advice needed; whether the judicial mind was not all important, to the exclusion of the engineering; and what type of engineer is best fitted for the work. There was no need to ask the questions. Mr. Straus gave his views without pausing for questions, anticipating all of the queries it had been proposed to propound.

Advised Engineer's Appointment

"As chairman of this commission," said Mr. Straus, "I welcomed and advised the appointment of a high-class engineer as a member. The Governor, however, forestalled my ideas as he had, for some time past, before my appointment, come to the same conclusion that I subsequently reached. He carried out his views in a most excellent manner by inducing Mr. Hodge to accept the position. A man of Mr. Hodge's experience and standing is not a mere engineer. He has in the fullest sense of the word a constructive mind.

"The reason why an engineer of high standing is of such value to the commission is because fully half of our problems are construction problems. A man looking at them from the administrative point of view, and uniting with that attitude expert knowledge as an engineer, is of enormous help to our engineering force, which naturally looks at problems from the purely engineering aspect. Furthermore, an experienced engineer who has been connected with large works is in the very nature of things a broad-minded and a practical man. He possesses qualities that cannot but be helpful in the solution of such problems as the commission deals with.

"The reason why the engineering mind is so valuable in such work is that it unites what Carlyle characterizes as the articulate and the inarticulate qualities—the power of formulating proposals united with the power of construction—deeds together with words.

"We were particularly fortunate in securing on our board such an exceptional man, who in experience, character and ability is so well qualified to aid in the solution of the problems before us as Mr. Hodge. Our engineering staff is excellent and the fact that we have on the commission itself a member with full responsibility, who also understands the technical problems, will be an aid in solving the very important questions before us."

Colorado River at Thirty-Four-Foot Stage Inundates Yuma

On Jan. 22 the Colorado River reached the 34-ft. stage at Yuma, which is equivalent to a flood four feet deep on the ground floors of buildings along the main street, and is the highest level on record since 1891. Many old buildings in the lower portions of the town were destroyed, and the gas, electric and water services were put out of commission. The Government levees gave way, both above and below Yuma, flooding the Arizona side of the Yuma valley and completely inundating the town of Araz and the Indian Reservation. The Government levee had to be cut at one point to release water.

President of Technical Publishing Company Who Died Suddenly This Week

JOHN ALEXANDER HILL

Due to ample warning no fatalities occurred in Yuma, except for the death of Mayor Moore, caused by shock. A citizens' relief committee promptly undertook to feed and shelter the homeless, and on Jan. 23 electricity, light and water were being supplied by auxiliary plants brought by the Southern Pacific Railroad from Tucson. On Jan. 24 railroad traffic west of Yuma was still blocked by the washout at Araz station, and the flood waters at Yuma had lowered to the 22-ft. level. J. C. Allison, chief engineer, California Development Company, reported by telephone from Hanlon heading that the water was four feet below levee tops and the canal system intake was safe.

Conditions in the Volcano Lake Levee District were not considered serious, because the duration of the flood peak was short, and the overflow above this point served as storage.

A telegram to the Engineering Record from A. B. Fletcher, chief engineer California Highway Commission, stated that, although the recent Southern California floods had damaged many county highway bridges, damage to the state road system was comparatively slight, probably totaling less than $10,000.

John A. Hill, Publisher of Technical Journals, Dies Suddenly

Owner of "Engineering News" Stricken by Heart Disease—Arose from Locomotive Engineer to Presidency of Large Publishing Company

John Alexander Hill, president of the Hill Publishing Company, publisher of *Engineering News*, the *American Machinist*, *Power*, the *Engineering and Mining Journal*, and *Coal Age*, died suddenly of heart disease Jan. 24 while motoring from his house in East Orange, N. J., to his office in New York City. His death ends a career filled with dramatic interest—the rise of a farmer's boy, reared in the humblest surroundings, through the ranks of printer's "devil," machinist, locomotive engineer, and round-house foreman to a position in which he was one of the dominating influences in the field of technical journalism. Mr. Hill was essentially a self-made man, with a vigor of personality and a strength of determination which swept obstacles aside, but he had none of the objectionable egotism which is sometimes a characteristic of men who have risen to power through the sheer force of their own efforts.

He was born on a farm in Sandgate, near Bennington, Vt., Feb. 22, 1858, and while still a lad his parents moved to Wisconsin. His ambition for doing things asserted itself early in life, for he left the public schools when he was only fourteen years old to enter upon his first job in a country printing office. Here he remained until he had saved enough money from his meager earnings to buy a half interest in a small machine repair shop. Here it was that his inborn aptitude for mechanics developed and in 1878, when he had reached the age of twenty, he went to Colorado to run a locomotive on the Denver & Rio Grande Railroad. Mr. Hill's journalistic instincts soon began to crystallize. He was a keen observer of the things that passed before his eyes, and he commenced to translate his daily experiences on the railroad into "copy," sending his contributions to a small paper, *Locomotive Engineering*, published in New York by a company which also controlled the *American Machinist*. His forceful, breezy style and his evident grasp of the practical details of railroading made such a favorable impression that he was offered an editorship on the paper to which he had been sending his manuscripts. He left the railroad, came to New York and began work as an editor.

His First Paper

It is characteristic of the man's rugged power that in a short time he owned the paper which had offered him a job. He had not been writing for *Locomotive Engineering* long before he saw in the enterprise possibilities which had never been grasped by its owners. He promptly enlisted the support of Angus Sinclair, purchased the journal, and undertook to carry it on as a separate publication. In this venture Mr. Hill was both editor and publisher, and his genius was well proved by the phenomenal success of the publication. Its subscription list grew by leaps and bounds, and it rapidly assumed the leading position in its field.

It was evident to Mr. Hill's keen business sense, however, that a journal appealing largely to locomotive runners had not the elements for the largest financial success, and he perceived the opportunity of applying modern business and editorial methods to the *American*

Machinist, a journal of standing and reputation, which had been conducted for years along ultra conservative lines. In 1896 Mr. Hill sold his interest in *Locomotive Engineering* to his partner, Mr. Sinclair, purchased the *American Machinist* and laid the foundation for one of the largest enterprises in the field of technical publication ever established.

From the time of his acquisition of the *American Machinist* his activities in the publication field rapidly expanded. He purchased *Power*, and soon afterward the *Engineering and Mining Journal*. In 1912 *Engineering News* passed into his control from its founder and chief owner George H. Frost.

To carry on these various publications Mr. Hill organized the Hill Publishing Company, in which, while he held the largest interest, a number of those associated in the conduct of the various journals were also stockholders. A fifth journal, *Coal Age*, was established in 1911 to cover a field which it had become evident was too broad to be successfully reached by the *Engineering and Mining Journal*, chiefly devoted to metal mining interests.

In addition to his control of engineering periodicals Mr. Hill was a prominent factor in the technical book publishing business. In 1909 he became associated with James H. McGraw, publisher of the Engineering Record, and the McGraw-Hill Book Company was formed. This partnership involved only the book publishing interests of the McGraw and the Hill organizations, and involved no amalgamation in the production of the several technical journals controlled by Mr. McGraw and Mr. Hill.

An enterprise in which Mr. Hill took great pride and to which he devoted some of the best energy of the last years of his life was the construction on Tenth Avenue and Thirty-sixth Street, New York City, of the building to house his publications, which was completed in 1914. It was characteristic of Mr. Hill that the building was not only planned at every point to suit the convenience and economy of the printing and publishing business, but that unusual provision was made for the safety, comfort and health of the army of workers housed in the building.

Mr. Hill was married in Wisconsin in 1882 to Emma B. Carlisle, who, with one daughter survives him.

Mr. Hill was vice-president of the Machinery Club, a member of the Engineers' Club of New York City, Railroad Club, Campfire Club and of the American Society of Mechanical Engineers, to which he was elected in 1913, among his references being Thomas A. Edison and James Hartness.

Spend $4,623,880 in 1½ Years for Surfacing Lincoln Highway

Expenditures in hard-surfacing the Lincoln Highway in the past eighteen months have amounted to $4,623,880, all of the money being paid by the various communities along the route.

Water Main Break in Cleveland Damages Railway Tracks

Cleveland's West Side section was without water supply or fire protection for several hours Jan. 20, due to a break in a 42-in. water main under Spruce Street at the Sycamore Street slip. The rush of water was so great that over 200 ft. of railroad track were washed out. The break occurred at the lowest point of the water system leading to the West Side, and all house connections and mains were drained almost immediately.

For six hours, until a by-pass could be put in use, 175,000 persons were without a water supply or fire protection. The main which gave way was of cast iron, 1¼ in. thick, and has been in the ground twenty years. Water Commissioner Schulz stated the break, which occurred at a joint, was due to settlement of earth underneath the main.

Agree on Rivers and Harbors Bill

Claude Kitchin, chairman of the House Ways and Means Committee, announced Jan. 25, following a conference with President Wilson at the White House, that a rivers and harbors bill had been agreed on. It will carry an appropriation of $24,000,000 for the purpose of paying for projects already authorized. It is predicted that there will be no omnibus appropriation for public buildings at this session of Congress. Appropriations all along the line are being cut in anticipation of the needs for military preparedness.

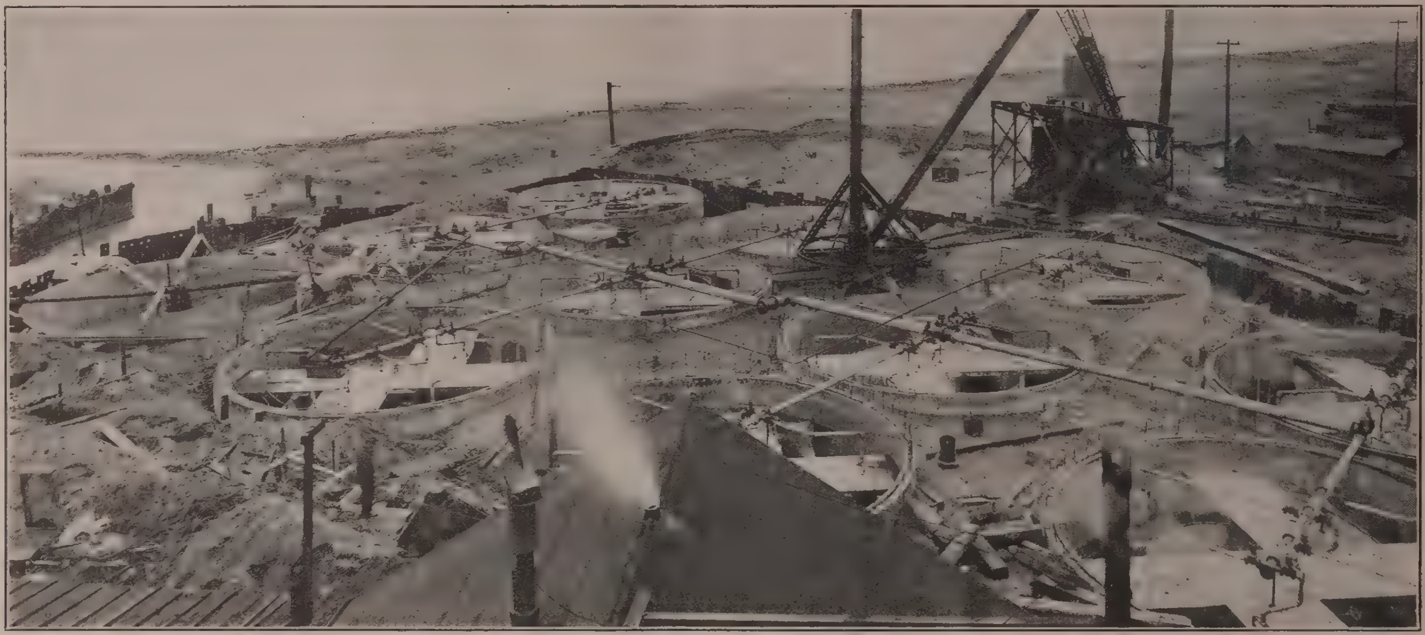
New Reinforced-Concrete Docks Planned for Asuncion, Paraguay

Plans for the construction at Asuncion, Paraguay, of approximately 1500 linear feet of new reinforced-concrete docks, with ample storage warehouse space and modern freight handling facilities and traveling cranes, have been submitted for approval. It is expected that active construction will begin within 90 days. The new docks will replace the five present totally inadequate, dilapidated wooden docks in front of the Custom House. Asuncion is a good natural port on the Paraguay River, which is navigable for large steamers all the way to the Atlantic Ocean. The construction and operation of the new works will be undertaken by MacArthur, Perks & Company, Ltd., and the contractors are the Construction & Engineering Finance Company, both allied with MacArthur Brothers Company of New York City.

Pioneer Activated Sludge Plant in Service

First Large-Scale Installation of New Process of Sewage Treatment Put Into Continuous Operation at Milwaukee

The 2,000,000-gal. activated sludge sewage treatment plant at Milwaukee is completed and has been put into operation. The accompanying photograph shows the sedimentation tank at the extreme left. It is to be covered later with a wooden roof. At the extreme right of the sedimentation tank are the two sludge aerating tanks. The other eight tanks are for aerating the sewage. The air pipes are seen on top of the tanks.



PIONEER ACTIVATED SLUDGE PLANT AT MILWAUKEE WHICH WAS RECENTLY PLACED IN REGULAR SERVICE

A complete description of the plant by T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, appeared in the Engineering Record, Oct. 16, 1915, page 481. Up to the middle of January the plant was in partial operation on the fill-and-draw method for the purpose of building up sufficient activated sludge to warrant starting the continuous flow. When operating with 25 per cent of sludge in the aerating tanks and with a 4-hr. running-through period the capacity is 1,620,000 gal. per day. The sedimentation period is 27 min. and the velocity of the liquor through the eight aerating tanks over the 912-ft. direct travel is 3.8 ft. per minute. Decreasing the running-through period to 3 hr. increases the capacity to 2,160,000 gal. per day and the velocity to 5 ft. per minute.

Compressed air is furnished by a motor-driven Connersville positive blower having a capacity of 2400 cu. ft. of free air per minute compressed to 5 lb. The two complete units provided cost $2,986.69 erected, including the frame blower house.

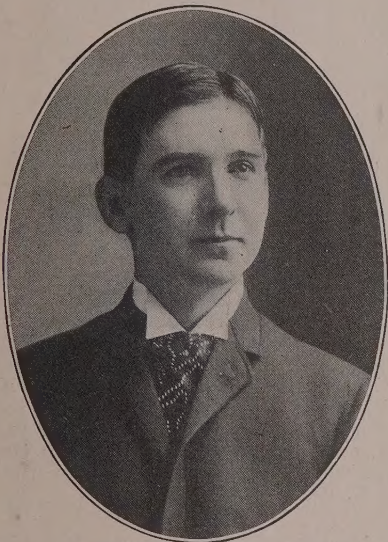
The volume and rate of air supplied to the whole plant and to the sludge tanks is measured by General Electric indicating recording integrating meters costing $314.25 and $305.25 respectively.

The contract price for building the eleven tanks, including seventy-two 40-ft. piles for foundations under each tank and piping complete, was $55,000.

Sullivan Heads New England Waterworks Association

William F. Sullivan was elected president of the New England Waterworks Association at the annual meeting held in Boston, Jan. 12. He joined the organization in 1900 and is at present engineer and superintendent of the Pennichuck Waterworks, Nashua, N. H. Mr. Sullivan for a number of years past has taken an active part in the New England Association's work. He was a vice-president last year and has been identified with the organization's committee work. He was born at Lowell, Mass., in 1868, and began work as an assistant in the city engineer's office of that municipality. He advanced through the lower engineering grades until he was placed in general charge of the Lowell Waterworks. Later he went to Nashua, N. H., to enter upon his present duties.

Elected President of New England Waterworks Association at Annual Meeting



WILLIAM F. SULLIVAN

The other officers elected were: Vice-presidents, C. M. Saville, C. E. Davis, S. E. Killam, R. S. Lea, D. A. Heffernan and W. W. Brush; secretary, Willard Kent; treasurer, L. M. Bancroft; editor, R. K. Hale.

Northern Illinois Water Supplies Imperiled by Unusual Floods

"Boil the water" notices appeared last week in the Chicago papers following an unusually heavy 24-hour rainstorm on top of the frozen ground, a condition that backed water into the Sixty-eighth Street pumping station until it stood at a level 2 in. above the top of the open suction well extending up through the floor. The water department was prepared for a much higher level, having banked sand bags around the well. "We could not see and do not believe any seepage got into the supply," said one of the officials, "but we asked that the notices be printed so as to be on the safe side."

The supply to the station is sterilized at the crib and an extra amount of chlorine was added during the flood period, but of course it is not considered likely that it would act on a subsequent pollution if there was one.

Numerous basements throughout the city were flooded and practically all subways under elevated tracks on the South Side were filled with from 2 to 6 ft. of water. The antiquated sewer system of Chicago was taxed beyond its limits and the question of rebuilding it in the downtown district along with any subways now being agitated was forced home on the layman.

Reports from northern Illinois towns indicate that the sewer systems in many of them are entirely inadequate. West Hammond had 2½ ft. of water in its streets. The Fox River at South Aurora was dynamited to break an ice jam forcing the water into the Aurora pumping station. Joliet reported 2000 people driven out of their houses, and streets filled with ice left by the receding waters. At Peoria the Illinois River registered 24.1 ft. on Jan. 23, 0.1 ft. higher than the previous record made in 1882. The weather bureau predicted a further rise of 2 ft. A levee opposite the city protecting 4000 acres broke, forcing 100 families to abandon their homes. Water poured 3 ft. deep over some of the levees in this region. The 12,500-acre Spring Lake drainage district was flooded from breaks in the levees holding back the Mackinaw River.

Flood Damage Severe in Los Angeles County

Floods due to heavy rains descending upon California, Jan. 16 and 17, caused losses of not less than $3,000,000 and the lives of at least four people. In Los Angeles County, where the citizens will soon have a chance to vote on a $3,600,000 bond issue for flood control and conservation work, rich agricultural lands were overflowed and soil carried away, railroads washed out, streets and roads cut away, bridges destroyed and buildings wrecked.

The high water in and around the city of Los Angeles came near to being as disastrous as the flood two years ago, which was the direct cause of the agitation for flood prevention work. In 36 hours, more than 6 in. of rain fell. Cloudbursts, having their source in the mountains, swept down upon the fertile plain upon which are situated practically all the cities and towns of Los Angeles County, and, uniting there with swollen streams, cut new channels and spread out over wide areas on their way to the ocean. At the harbors, channels were filled with silt and dredging will be necessary to keep them navigable.

All of the railroads suffered. The San Pedro, Los Angeles & Salt Lake tracks were washed out at different points between Los Angeles and Riverside, and over a mile at Walnut, while the Southern Pacific lost several hundred feet of its line at Whitewater and some at Moorpark, Pacoima and Tejunga Pass. The Pacific Electric interurban service was almost completely suspended for a time, a number of towns being completely isolated. The Atchison, Topeka & Santa Fé lines also went out at points near Cajon, Upland, Glendora and San Diego.

A number of bridges were washed out, while others were undermined and threatened, including the Pacific Electric bridges at Rio Hondo and Rivera, the Southern Pacific bridge at Downey, the Los Angeles city bridges at Avenues 52 and 60, and all county bridges within five miles of Azusa, and also along the Foothill boulevard, on the Compton-Clearwater highway, and at other points.

Valuable industrial property bordering on the banks of the Arroyo Seco and Los Angeles Rivers, in Los Angeles, was cut away. In the residential districts streets and sewers caved in, and, it is said, houses were flooded and trees uprooted.

House Approves $25,000,000 Federal Aid Road Bill

The House of Representatives on Jan. 25 passed the Shackleford bill, which authorizes an appropriation of $25,000,000 to aid states in the building of public highways. The vote was 281 to 81. The measure was opposed by those who believe that all available money should be used for increased military preparedness.

Civil Engineer Becomes Vice-President of International Corporation

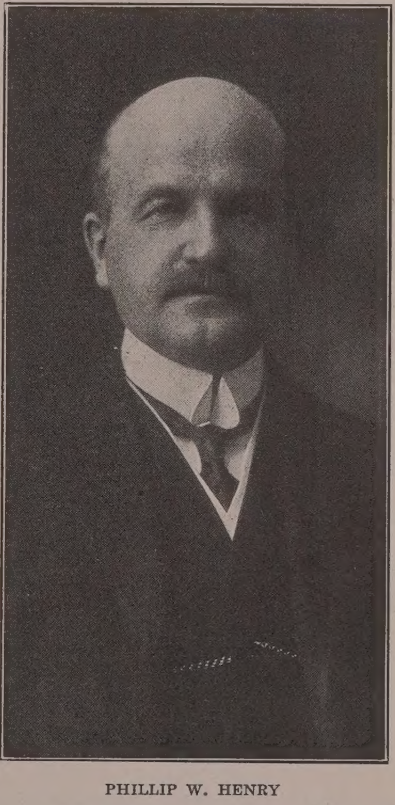
Philip W. Henry Elected an Officer in $50,000,000 Company Recently Organized for the Exploitation of Foreign Trade

Philip W. Henry, consulting civil engineer, of New York City, has been elected vice-president of the recently organized American International Corporation, the purpose and scope of which was briefly outlined on page 93 of the Jan. 15 issue of this journal.

Mr. Henry has for many years been prominently identified with developments in the West Indian and South American fields in which the corporation, among its other activities, will operate. Since 1909 he has been president of the Central Railroad of Haiti, which owns and operates 60 miles of railroad in that country, a modern reinforced-concrete wharf at Port-au-Prince, which represents the only real harbor improvement completed in that port since the founding of the republic over a century ago, and the tramways and electric light plant of the city.

In various official capacities with the Barber Asphalt Company he had much to do with the development of the Bermudez asphalt deposit in Venezuela, and that on the Island of Trinidad. From 1906 to 1909 he was president of the South American Construction Company, which built 125 miles of railroad in Bolivia. Other activities have taken him to Spain, Peru, Brazil, Mexico, Chili and the Argentine Republic.

Elected Vice-President of American International Corporation



PHILLIP W. HENRY

Started Career in Railroad Work

Mr. Henry was born at Scranton, Pa., and, after three years service in the engineering corps of the Delaware, Lackawanna & Western Railroad, on the location and construction of its extension from Binghamton to Buffalo, received his professional education at the Rensselaer Polytechnic Institute, from which he was graduated in 1887 with the degree of civil engineer. He then became foreman of the works of the Barber Asphalt Paving Company at Buffalo, and was made assistant superintendent the following year. In 1889 he became superintendent for the company at St. Joseph, Mo., and at Omaha, Neb. In 1897 he became general manager in New York, and, in 1900, attained the grade of vice-president and general manager. He left the company in 1902 to become vice-president of the Medina Quarry Company, and, in 1904, he opened an office in New York as consulting engineer. Since then he has been vice-president of the A. L. Barber Asphalt Company, operating the Bermudez asphalt deposits in Venezuela, and president of the South American Construction Company, which built 125 miles of railroad in Bolivia from Viacha to Oruro, all of which was built at an altitude of 12,000 ft. and over.

Since 1909 he has been president of the Central Railroad at Haiti, which owns sixty miles of railroad and the wharf, tramways and electric light plants at Port-au-Prince. He is also president and director of the Achotla Mines Company, which owns gold and silver mines in the state of Guerrero, Mexico.

Made 700-Mile Railroad Reconnoissance in Spain

In 1910 he made a railroad reconnoissance in Spain, traveling a distance of 700 miles, studying a proposed line from Bilbao to Madrid, and thence to Valencia.

In 1893 he made the only borings ever made in the pitch lake in the Island of Trinidad, which reached to a depth of 135 ft. in the center without reaching bottom, thereby demonstrating the inexhaustibility of the supply so far as the present generation, at least, is concerned. In 1904 and 1905 he spent some months in the state of Vera Cruz, Mexico, making an examination of the oil fields in that region, and making a survey of a railroad to develop the resources of that part of Mexico. This latter work was done for the Pan-American Company of Delaware, of which he was at the time vice-president. In 1911 he was appointed president of the Eddy-Peruvian Company, which in 1912 and 1913, made a railroad survey for the Peruvian Government, 200 miles in length, from Huancayo to Ayacucho, through a very difficult country.

Of recent years he has devoted considerable attention to the development of oil properties, and from 1911 to 1914 was consulting engineer for the Southern Pacific Railroad with special reference to the development of its oil properties in California, Texas and Mexico.

Recently he returned from an extended trip through Brazil, the Argentine, Chili and Bolivia, looking up the railway and public utility situation in those countries.

Wood Preservers Present Service Test Facts

Chicago Convention Program Replete with Results of Treated Paving Blocks, Bridge and Structural Timbers and Cross-Ties

Committee reports on treated timber for various uses were the feature of the convention of the American Wood Preservers' Association held in Chicago Jan. 18 to 20. When J. H. Waterman was elected president of the organization last year he began a campaign for the collection of facts, the information submitted to the annual meeting last week is the result of his effort to secure data upon which to base conclusions as to the best uses of wood and its preservatives.

So the program this year fairly bristled with facts on the longevity of wood block paving, on the significance of an innocent-looking fungus on the end of a cross-tie, on the suitability or undesirability of wood blocks for factory flooring, on the enormous waste of wood piling in water not infested with marine borers, and on results obtained under service with treated bridge and structural timbers.

Last year the West Coast representatives announced that they were on the eve of discovering a method of treating Douglas fir successfully. O. P. M. Goss, consulting engineer, of Seattle, presented a paper detailing the methods.

Service Test Results

A. E. Larkin, chairman of the committee on service tests of wood block paving, gave details of pavements in good condition, which had required an insignificant amount of maintenance in Minneapolis after thirteen years, in Seattle after seven years and in Newark after seven years.

On bridge and structural timbers the committee headed by H. M. Rollins added to the elaborate report of 1915, data from twenty-four different structures, mostly railroad trestles, piles and wharfs.

In the report on service tests on cross ties the chairman, C. P. Winslow, presented a mass of facts on the durability records of treated and untreated ties, involving more than 50 species, including 1200 individual records. The compilation was made by Messrs. Winslow and Teesdale, of the Forest Products Laboratory. Information of ties in the tracks of electric railways is desired by the committee, which was continued.

Mr. Winslow in a separate paper presented information on the composite strength value of thirty-five species, the factors being specific gravity, nail pull resistance, hardness, static bending, and compression, parallel and perpendicular to the grain.

Oil Specification Most Debated Question

The special report on a wood block preservative specification presented by S. R. Church furnished food for the most exciting discussion during the convention. Discussion on practically the same specification was looked for at Dayton at the meeting of the American Society of Municipal Improvements, but was held by that society in committee cold storage for another year. The proposed specification is confessedly a broad one and would let in nearly every kind of oil derived from coal gas tar or coke oven tar. Herman von Schrenck contended that practically all oils gave equally good protection against decay, "so why quibble over the oil specification when the real difficulty lies in getting the proper treatment." The water gas people felt that provision should be made for their oil, and presented a long brief in support of their contention. The committee members answered that as yet they had not become acquainted with sufficient service records to warrant advocating its use as standard. By a close vote the contenders for adoption of the specification as a standard of the society were defeated. The report was received as information and referred to the standing committee on preservatives.

The wood block paving report presented by C. H. Teesdale was very materially changed by the committee of which he was chariman from that printed as an advance paper. So many changes were suggested from the floor that it was referred back to the committee until another year.

E. A. Sterling, chairman of the committee on specifications for the purchase and preservation of treatable timber, presented specifications for structural timber, track ties and piling only. Wood blocks are under consideration by a special committee, and poles, mine timbers and other classes of material were left for future consideration.

Toxicity Test on Marine Borers

Dr. L. F. Shackell, St. Louis University, detailed tests on the toxicity of preservatives on the marine borer Limnora, based on 7000 observations. His findings bore out what he reported last year with reference to Xylotrya, namely, that the toxicity of creosote fractions diminished with rise of boiling point, the light oils are very toxic, naphthalene and anthracene are practically non-toxic and the tar acids are extremely toxic.

Herman von Schrenck had a tableful of treated and untreated specimens which showed bad decay, although apparently the timber was sound on the outside. He explained the factors contributing to these failures, some of which are treating timbers already decayed, failure to keep storage yards free from decaying sticks, and the impossibility of treating sap wood if it is already filled with water.

Society Affairs

The publication of a manual of suggested practice was urged. This was provided for last year, but it has not yet been carried out.

President Waterman suggested that a research committee be formed to investigate all new methods, patented or not.

A new constitution was adopted providing for probate membership instead of junior membership. The probate member should within five years be eligible for corporate membership. The time of meeting was changed to the fourth Tuesday in January to avoid conflict with the annual meeting of the American Society of Civil Engineers. A letter ballot for officers was adopted.

The secretary reported a membership of 276, a gain of 11 over the previous year.

A conference committee was authorized to work in co-operation with other organizations with the idea of cutting down the number of requests sent out each year to various companies and engineers. New York was chosen as the place for the next annual convention.

The officers elected for the ensuing year are as follows: President, Carl G. Crawford, general manager, American Creosoting Company; first vice-president, John Foley, chief forester, Pennsylvania Railroad Company; second vice-president, Morris K. Trumbull, vice-president, National Lumber & Creosoting Company; secretary-treasurer; F. J. Angier, superintendent of timber preservation, Baltimore & Ohio Railroad, Baltimore; members of executive committee, F. S. Pooler and A. R. Joyce.

Engineers Serving the Public to Receive Recognition

John W. Alvord Gives Western Society of Engineers $1,000 As Nucleus of Fund for Annual Honorary Medal or Tribute

An honorary award for inconspicuous engineering service to the public is to be made each year by the Western Society of Engineers from funds provided by the gift of $1,000 by John W. Alvord, consulting engineer of Chicago, which was noted on page 97 of the Jan. 15 issue of this journal. The purpose of the award and the extreme latitude given the society in making it are expressed best in Mr. Alvord's letter to the board of direction, printed below.

"It has long been my observation that there are numerous instances where the engineer serves the public amid many difficulties and often in inconspicuous ways, but with such ability that he accomplishes some particularly valuable results for the benefit of the community. Such achievements are often only known and not always properly acknowledged even by the profession to which he belongs, and they not infrequently entirely escape public notice.

"Further, it is well known that great benefits often accrue to the public at large through valuable improvements in the arts and their adaptation to the public use and need, and that these improvements are at times given by engineers to the public use without personal reward or gain.

"Finally, there is a class of engineers who, although substantially rewarded in a material way by the success of their work, nevertheless have accomplished so much for the world about them in vital, important and far-reaching ways, that they are deserving further of special honor for their accomplishments.

"It is not always clearly perceived that almost all engineers serve the public directly or indirectly. The field for useful public service is, therefore, about as wide as the profession, and it would appear that it is one of the important duties of engineering societies to point out to their membership and to the public such instances of engineering and administrative skill as seem to have unusual merit, in order that honor may be properly accorded where it is due.

"Being desirous of promoting a better appreciation by the public of able work accomplished by engineers for the public welfare, and further, of encouraging among engineers themselves a broader understanding of their opportunities for public usefulness, I desire to see established by the Western Society of Engineers an honor award—by medal or other tribute—to be annually presented to that engineer whose particular work in some special instance or whose services in general have been noteworthy for their merit in promoting the public good. I should be pleased if the recipient of such honor be not limited by Western Society membership, or, in fact, be restricted by any society or locality requirement. The only qualifications suggested are that he be an engineer of some reasonable degree of professional skill or administrative attainment. It would appear that the award will serve its purpose wisely if at times it is worthily bestowed upon comparatively little known instances of public and professional devotion, as well as at other times upon more conspicuous services.

"I trust, therefore, that the Western Society of Engineers, through its board of direction, may be willing and enable to administer some program of this kind in such manner and in such instances as from time to time seem to the board of direction best and most fitting; and for the purpose of enabling the society to have an income sufficient at least to make a beginning, I take pleasure in donating to it unreservedly the sum of $1,000 in securities."

Personal Notes

William McNab, formerly principal assistant engineer of the Grand Trunk Railway at Montreal, has been appointed valuation engineer. Mr. McNab was born in Scotland, and entered railway service on the Grand Trunk in 1870, on work in connection with the International Bridge across Niagara River. Later he assisted on the location and construction of the Lewiston & Auburn. In 1878 he was appointed engineer of surveys and levels for projected revision work, and, in 1880, engineer of location and construction of the Montreal & Champlain Junction Railway. From 1883 to 1884 he was in charge of double tracking from Scarborough to Montreal, including the York Yard terminals and engine house. For 10 years, beginning in 1886, he had charge of the drafting office at Montreal, including part of the design and control of construction of the terminal passenger station in that city. From 1896 to 1907, as assistant engineer, he assisted the chief engineer on various work, including the extension of piers, and replacing the single-track Victoria Tubular Bridge across the St. Lawrence River with double-track steel trusses. He was appointed principal assistant engineer in 1907.

Ellms & Miller, consulting engineers, of Cincinnati, have been retained to supervise the construction, and to act as consulting engineers, of the extension of the approach to the Covington & Cincinnati Bridge, which is to be built this year. The approach will be of steel girder and concrete construction.

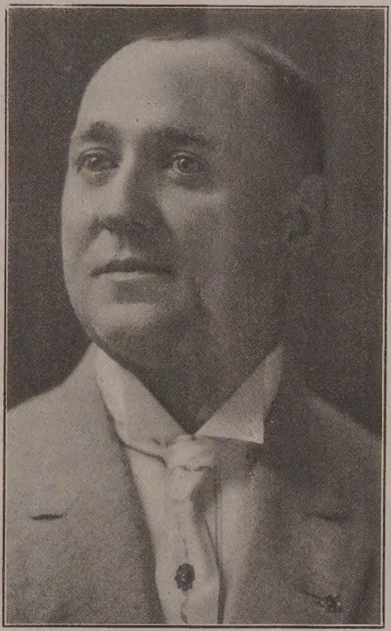
G. A. Knapp has been appointed acting engineer of the Beaumont division of the Gulf Lines of the Atchison, Topeka & Santa Fé Railway.

C. R. Sumner has been appointed city engineer of Hermosa Beach, Cal.

Charles Frommer, formerly assistant engineer of sewer design of the Bureau of Surveys, Philadelphia, has been appointed principal assistant engineer of the bureau. Mr. Frommer received his professional education at Drexel Institute, and first engaged in engineering work in 1888 on the Lehigh Valley Railroad. From 1892 to 1894 he was structural draftsman with the Pencoyd Iron Company. He entered the service of the city of Philadelphia as sewer draftsman in 1894. In 1904 he was appointed assistant engineer of sewer design in full charge of all draftsmen and work necessary for the entire city, including the design of over 27 miles of main sewers, totaling more than $3,000,000 in cost, and of over 139 miles of branch sewers.

Frank S. Krug, city engineer of Cincinnati, was unanimously chosen administrative head of the proposed Cincinnati Rapid Transit & Interurban Railway project by the unanimous vote of the Rapid Transit Commission of that city at its meeting, Jan. 22. Mr. Krug is also to be chief engineer of the commission, and will have charge of the actual construction if the citizens approve the $6,000,000 bond issue for the improvement that is to be submitted to them in April. Mr. Krug's appointment to this post is in recognition of his past work in the public service. Following his graduation from Pennsylvania Military College, in 1884, with a degree in civil engineering, he obtained a position in the office of the county engineer of Hamilton County, Ohio, and rose to the rank of assistant county engineer. In 1891 he became county engineer, which office he held for 14 years. In recognition of his work his alma mater conferred the degree of master of engineering on him in 1904. Following his service with Hamilton County, Mr. Krug became associated with the Kirchner Construction Co., of Cincinnati, Ohio, as secretary and chief engineer. In January, 1914, he accepted the appointment of city engineer of Cincinnati, succeeding Henry M. Waite, who resigned to become city manager of Dayton. As city engineer Mr. Krug has been particularly successful in his method of handling the street repair department, which he has reduced to an economic and efficient basis by various technical innovations of his own origination.

City Engineer Appointed Head of Cincinnati Rapid Transit



FRANK S. KRUG

G. W. Cunard has been appointed city engineer of Port Angeles, Wash.

John H. Hanna, formerly chief engineer of the Capital Traction Company of Washington, D. C., has been elected vice-president of the company, and will have charge of operations. Mr. Hanna was graduated from Princeton University in 1892, and joined the engineering forces of the Louisville, St. Louis & Texas Railroad, as transitman on preliminary surveys and location, in August of that year. In 1894 he went to the Washington & Georgetown Railroad Company—now a part of the Capital Traction Company—as draftsman. He was appointed assistant engineer in this service in 1894, and assistant superintendent in 1895. In 1897 he attained the grade of assistant chief engineer and superintendent. He was appointed chief engineer about 7 years ago.

W. G. Massenburg, formerly division engineer for the Atchison, Topeka & Santa Fé Railway at Beaumont, Tex., has been appointed acting engineer of the Gulf Lines, with headquarters at Galveston.

Farley Gannett and Theodore E. Seelye of Harrisburg, Pa., have admitted Samuel W. Fleming, Jr., to the firm of Farley Gannett, consulting engineer, and have broadened their field of activity by including the design, construction, valuation and operation of electric properties. Mr. Fleming was graduated from Princeton University in 1906. He then studied engineering at Lehigh University, graduating from that institution in 1909. For three years after graduation he was identified with the Central Hudson Gas & Electric Company, acting as power engineer for a considerable part of the period, and devoting much attention to the revision of the rates of the company. For the last few years he has been largely employed in making reports on and investigations of electrical properties in the East and Middle West, including the White Rapids hydroelectric development in Michigan and Wisconsin, the Sturgeon River development in Michigan, and steam electric properties in the same territory. He has also been employed on reports upon electric railroads in New York and Maryland. Mr. Fleming will devote himself to the electrical work of the firm, giving especial attention to the design and construction of electric properties for corporations and municipalities, valuations for rate adjustments, and the operation of properties will also be undertaken for corporations and municipalities. The firm will continue to represent, as heretofore, public utilities, other corporations, municipalities and individuals before the State departments and commissions of Pennsylvania.

M. L. Hutton, formerly connected with the Central States Engineering Company, of Muscatine, Iowa, has been appointed county highway engineer for Des Moines County, Iowa, succeeding Raymond Duer. Mr. Hutton was county highway engineer of Louisa County, Iowa, from 1912 to 1914, and, in 1915, was in the employ of the Central States Engineering Company of Muscatine, Iowa. Previous to 1912 he was employed in the engineering department of the Chicago, Milwaukee & St. Paul Railway on the Puget Sound extension, and in that of the Great Northern Railway on maintenance-of-way work. In 1911 he was engaged in drainage engineering in Humboldt County, Iowa.

Arthur Crumpton, formerly assistant engineer for the Grand Trunk Railway at Montreal, has been appointed assistant valuation engineer. He entered railway service in 1889 on the Grand Trunk, and was appointed assistant engineer in 1892. From 1893 to 1896 he was engaged in general maintenance work on the Great Western division, and, from 1897 to 1901, he was on field and office work in connection with the permanent renewal of 300 bridges, including the Victoria Bridge over the St. Lawrence River. From 1912 up to the present appointment he was engaged on surveys and construction in Ontario and New York State, and on bridge renewal work over the entire system.

Co-operative Russian-American Company Formed in Chicago

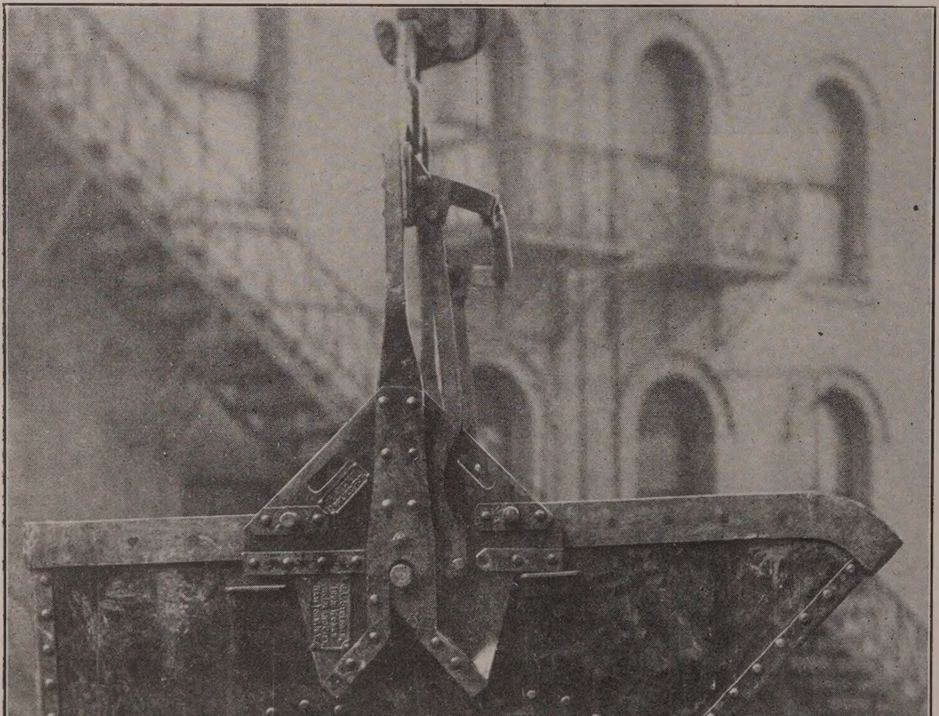
Twenty-five American non-competing firms have organized a co-operative organization with offices in the Rookery, Chicago, to push trade in Russia, to overcome the disabilities of different language, credit and business methods. It is called the International Manufacturers' Sales Company of America and has a capitalization of $100,000 to be subscribed by fifty non-competitors. A. S. Postnikoff was elected president at a meeting held last week of twenty-five representatives of firms having an aggregate capitalization of more than $200,000,000. A canvass is being made to obtain the remaining twenty-five firms provided for in the plan of organization.

Wheeled Skip for Subway Work Has Safety Latched Bail

The wheeled skips shown herewith were developed for use on the subway work described on page 152 of this issue. Not only are they low, being easy to load and requiring no cars for transporting them below ground, but they are handled by means of safety latched bails which can be put on and detached in a few seconds. Two of these are provided, one with wings on both sides of the bail engaging angle lugs on the skip, which insures the bucket against tipping from striking an obstruction at the shaft, and one with wings in front only. This allows the bucket to be dumped by tipping it with a trip line, but prevents it from turning turtle through the bail. The trip line is hooked to a lug at the back of the bucket.

Each of these bails has two latches, one on each side, which engage the trunnions on the bucket. They are connected by links and rods to a handle running across the bucket at the top of the bail. When this handle is raised, the latches are drawn aside by the links, leaving the slots in each side of the bail free so that it can be raised from the skip. In lowering the bail over the trunnions, its weight bearing on the latches forces them aside like a door latch until they have passed the trunnions, when the weight of the handle and links operates to throw the latches out and lock the bail to the skip. There is no way for the skip to slip out of this lock until the handle is raised, which cannot be done until the bucket is set down, because the weight of the skip exerts too great a friction on the latches through the trunnions, which bear directly on them. None of the moving parts can catch the men's fingers. The bail is strongly built and all parts are easily accessible. It is one of the inventions in this line of G. L. Stuebner, and patents on the rig have been applied for. The skips and bails are manufactured by the G. L. Stuebner Iron Works in Long Island City, N. Y.

BUCKETS ARE QUICKLY DUMPED AT DOCK



BAIL LATCHES ITSELF AUTOMATICALLY AND GRIPS BUCKET SO IT CANNOT DROP OR TIP

Business Notes

William A. Heartt, for the past five years in charge of the Western territory for the Sand Mixing Machine Company of New York, has been appointed assistant sales manager of the Chain Belt Company, manufacturer of chain belt and sprocket wheels, elevating and conveying machinery and concrete mixers, of Milwaukee.

The Apollo Electric Steel Company, which has just been organized, has acquired an 8-acre tract of land at Apollo, Pa., and has let contracts for buildings and equipment to start operations. The Snyder Electric Furnace Company of Chicago, will furnish two 12-ton single-phase furnaces, each of which will have a daily output capacity of 100 tons of steel. The concern plans to market high-grade steel in the shape of bars, billets and special products. The management of the affairs of the company will be in the hands of the following: Robert Lock, formerly of the Allegheny Steel Company and the American Sheet & Tin Plate Company, president and general manager; J. Arthur White, formerly with the American Sheet & Tin Plate Company; metallurgical engineer, W. E. Troutman, manager of the Vandergrift plant of the United Engineering & Foundry Company; J. E. Gallagher, real estate broker, Apollo, and Carl H. Booth, vice-president of the Snyder Electric Furnace Company, Chicago.

Trade Publications

The following companies have recently issued trade literature:

Milwaukee Concrete Mixer Company, Milwaukee, catalog, 78 pages, concrete mixing machines and pavers.

Carbic Corporation, Duluth, Minn., booklet, 12 pages, flare lights.

Owen Bucket Company, Cleveland, circular pamphlet, 16 pages, photographic, grab buckets.

Hydraulic Pressed Steel Company, Cleveland, catalog, 94 pages, pressed steel forms and appurtenances for concrete construction.

Municipal Engineering & Contracting Company, Railway Exchange, Chicago, catalog, 16 pages, Austin concrete mixers for concrete-road construction.

Kelley-Springfield Motor Truck Company, Springfield, Ohio, house organ, December, 1915, 16 pages, motor trucks, contract and military work.

Goheen Manufacturing Company, Canton, Ohio. Pamphlet, 4 x 9 in., 32 pages. Engineers and architects will be interested in this pamphlet for the reason that there is contained in its concise form useful information on protective paints and tables as to costs and spreading capacity of various paints in their application to structural, concrete and masonry work. The description covers Carbonizing, Coating, a chemically combined paint for steel and iron; Highway Red, for highway and railway steel structural bridges; Galvanum, for galvanized metals; Ornolack, for ornamental irons; Oxidized Carbon Cement, R No. 2, especially recommended for locomotives and trucks, R No. 1, for resisting brine and ammonia; Oxidized Carbon Cement, to prevent corrosion of steel or base of columns resting on masonry surfaces and for inaccessible parts of steel work and hulls of vessels; Concrewaltum paint, to finish concrete brick and masonry construction, and Flat Wall finish for plastered walls. Another valuable feature of the booklet is the inclusion of specifications covering each of these paints.